# Senior 4 Pre-Calculus Mathematics (40S) Standards Test

# Administration Manual for Supervising Teachers

January 2003

Manitoba
Education
and Youth

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Manitoba Education and Youth,
Assessment and Evaluation Branch,
Winnipeg, Manitoba R3E 3J5

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## Preface

This *Administration Manual for Supervising Teachers* is distributed to teachers and administrators, and must be read prior to administering the standards test. The rules and guidelines in this manual must be strictly observed to ensure the consistency of standards test administration.

Please use this manual in conjunction with the registration package, the *Policies and Procedures for Standards Tests* handbook and the *Information Bulletin* to gain a full understanding of the protocols and procedures associated with this test. This manual contains general information about the test, step-by-step instructions for the day of the test administration, and policies regarding absenteeism, lateness, violation of rules, etc.

If you encounter exceptional circumstances not addressed in this manual, or if you have further inquiries, contact Ray Novog, Administrative Officer, at 945-5580, or toll-free at 1 800 282-8069, extension 5580.

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# General Information

Manitoba Education and Youth develops all standards tests in collaboration with teachers from across the province. This standards test is based on the Senior 4 Mathematics Manitoba Curriculum Framework of Outcomes and Senior 4 Standards (2000).

The standards test is locally marked and counts for 30% of each student's final grade in the course. Marking instructions are provided by the department immediately following test administration. School principals will receive Senior 4 Pre-Calculus Mathematics (40S) Standards Test *Marking Guides* by January 21, 2003. The *Marking Guides* are to be stored in a secure location until 12:30 p.m. on January 21, 2003. Student results on the test will be released to students according to local policy on the date designated by local jurisdictions.

All students enrolled in Senior 4 Pre-Calculus Mathematics (40S), except those who have been exempted, must write the *Senior 4 Pre-Calculus Mathematics (40S) Standards Test* on January 21, 2003. However, a student may rewrite a mandatory provincial standards test at any regularly scheduled administration without being registered in the course (see *Policies and Procedures* for Standards Tests, Section 3.1)

Students are expected to write the standards test as scheduled near the end of the semester in which they take the course (e.g., January for first-semester courses, May/June for second-semester and full-year courses).

All schools should receive the test materials by January 13, 2003. Principals of public schools receive test materials from their division/district offices. Principals of independent and band-operated schools will receive test materials directly from the Assessment and Evaluation Branch.

The number of test booklets sent to each school is based on the October 15, 2002 registration information provided by the school. Please advise Ray Novog, Administrative Officer, at 945-5580, or toll-free at 1 800 282-8069, extension 5580, immediately if the number of students registered to write the test has increased since registration.

In the context of marking standards tests at the local level, Manitoba Education and Youth will:

- train representatives from local jurisdictions to act as local marking co-ordinators;
- collect and scan all *Answer/Scoring Sheets* from jurisdictions to provide them with test result summaries;
- centrally mark a random sample of locally-marked test booklets to provide feedback to jurisdictions on their local marking; and
- support provincially-funded local jurisdictions by providing $10.00 for each locally-marked test administered in accordance with the test schedule noted on the following page.

## Features of the test

The *Senior 4 Pre-Calculus Mathematics (40S) Standards Test* consists of two parts:

- Part 1—open-response questions where a scientific or graphing calculator may be used; and
- Part 2—selected-response, restricted-response and open-response questions where a calculator may not be used.

## Test schedule

The following table summarizes the schedule for the *Senior 4 Pre-Calculus Mathematics (40S) Standards Test*:

| Date | Session | Preparation Time | Activity | Time Required for Test |
|---|---|---|---|---|
| Tuesday, January 21, 2002 | 1 | 15 minutes preparation and instructions | Part 1 | 60 minutes |
| | | | Part 2 | 120 minutes |

**The test must be written between 8:30 a.m. and 12:30 p.m. on Tuesday, January 21, 2003.**

# Policies for Standards Tests

Principals and supervising teachers should be aware that *Policies and Procedures for Standards Tests* handbook has been distributed to all schools and is available on-line at http://www.edu.gov.mb.ca/ks4/assess/publications.html. This handbook outlines current policies and procedures related to the administration of standards tests and reflects the principles and guidelines contained in *Principles for Fair Student Assessment Practices for Education in Canada (1993).*

## Adaptations

Schools are asked to identify and submit requests for test adaptations **at the time of student registration**. These requests should be submitted on the *Request for Adaptations Form* included with the registration package. Following departmental review of the adaptation requests received, schools will be advised of the department's decision regarding these requests (see *Policies and Procedures for Standards Tests*, Sections 4.0, 4.1 and 4.2).

## Exemptions

Decisions for student exemptions that fall within the guidelines set out in *Policies and Procedures for Standards Tests* (Sections 5.0, 5.1 and 5.2) are made at the school level and do not require departmental approval. Schools are required, however, to report school-based exemptions on the *Student Exemption Report* included with the registration package. If additional student exemptions are needed after the registration deadline date, an additional *Student Exemption Report* should be submitted as soon as possible.

For exemptions that fall outside the parameters of policy and procedure guidelines, requests should be made **at the time of student registration**. Please submit requests in writing to Ernest Molgat, Director, Assessment and Evaluation Branch, 71–1567 Dublin Avenue, Winnipeg MB R3E 3J5.

## Re-read provisions

As the reporting of individual student scores on locally marked standards tests is the responsibility of each local jurisdiction, the re-read policy for these tests is determined locally. Should a re-read be required for a test booklet that has been sent to the department as a part of the feedback marking process, the department will return a photocopy of the test booklet upon request. Please contact Ray Novog, Administrative Officer, at 945-5580, or toll-free at 1 800 282-8069, extension 5580.

## Return of tests to students

Local jurisdictions decide whether to keep the test booklets or return them to students. The department will return the random sample of test booklets to schools within three months of marking.

## Test confidentiality

Test materials must be kept secure and sealed until administration.

Test booklets must not be reproduced nor information from them communicated in any way until test administration is completed.

The *Marking Guide(s)* is to be stored in a secure location until the test administration is complete.

## Student materials

Students may use the following materials as specified, during the *Senior 4 Pre-Calculus Mathematics (40S) Standards Test*:

- HB lead pencil
- calculator (scientific or graphing—Part 1 only)
- eraser
- ruler

Students are not permitted to exchange materials during the test.

The following materials must **not** be used during the test:

- class notes
- notebooks
- textbooks
- dictionaries

## Students leaving the room

Students are expected to remain in the room for Part 1 (60 minutes) and until they have completed Part 2 of the test.

However, any student who must leave and re-enter the room should be accompanied by a replacement supervisor. This practice ensures that the supervising teacher can remain in the test room with the students at all times.

## Late arrivals

Students who arrive more than one hour after the test has started are not allowed to write the test. Students who arrive late but within the first hour of the test are permitted to write but no extra time is allowed. The exception will be if students arrive late for reasons beyond their control. Under these circumstances, the local jurisdiction may allow extra time to write the test. The test however, may not start after 12:00 p.m. Please note that late students who are granted extra time may only use their calculators for Part 1 of the test (maximum of 60 minutes). The classroom teacher should record on the *Supervising Teacher's Report* the booklet numbers of students who arrived late and provide details of the circumstances which caused the student(s) to arrive late.

## Student absences

Standards tests cannot be written at a later date and reported as a standards test result. Therefore, schools have the responsibility to provide a final mark to absent students. The final mark for these students must be identified as a school-based assessment and evaluation practice only (see *Policies and Procedures for Standards Tests*, Sections 6.0, 6.1 and 6.2 for additional information).

## Responding to student questions

Avoid making any directing/guiding comments during the test, other than those required for distribution of materials and instructions to students.

No explanations, translations, rephrasing, clarifying statements or comments of a similar nature may be provided about the test content unless otherwise specified.

If a student asks a question related to test content, a suggested response is, "I'm sorry. I can't answer your question. Do your best with it."

Suspected errors in printing or wording should not be communicated to students unless specific instructions are received from the Assessment and Evaluation Branch. You may however, contact Neil Vadeboncoeur, Assessment Consultant, at 945-6715 or toll-free at 1 800 282-8069, extension 6715 to report any suspected errors.

## Violation of rules

The *Test-Taking Rules* are read aloud to students by the supervising teacher immediately before the test (see Appendix 1, p. 17).

Document any violation of rules on the *Supervising Teacher Report*. This documentation should include:

- the test booklet number; and
- a description of the circumstances, including available evidence.

The student may be permitted to complete the test.

The consequences of any violation of rules is a local decision.

## Damaged or misprinted material

Students should be assured that they will not be penalized for any obvious error in printing or wording. Local marking co-ordinators will be advised of any known errors before the marking session. Return the unused damaged booklet(s) with the reports and forms being sent to the department immediately after the test session.

### On test administration date

If a damaged or imperfectly printed test booklet is discovered **at the start** of the test session:

- replace the defective test booklet with a new test booklet; and
- print "DAMAGED" on the test booklet cover and on the *Attendance Form*.

### During test administration

If a damaged or imperfectly printed test booklet is discovered **during** the writing of the test:

- give the student a new test booklet (the student keeps the damaged test booklet until the end of the session);
- instruct the student to continue responding to test items in the new test booklet;
- collect both test booklets at the end of the test session;
- cross out the existing booklet number on the undamaged test booklet and change it to the original booklet number so that **all student responses are recorded under the original booklet number**;
- indicate on the *Attendance Form* that two booklets have been used for one student (see Appendix 3, p. 19);
- record the defective test booklet number on the *Supervising Teacher Report*; and
- ensure both booklets are kept together by bundling with an elastic band.

# Responsibilities of School Principals

It is the responsibility of the principals to ensure that the tests are kept confidential until test administration is completed.

Other responsibilities are listed below.

If tests are not in your school by January 13, 2003:

- public school principals should contact their superintendent;
- principals of independent and band-operated schools should contact Ray Novog, Administrative Officer, at 945-5580, or toll-free at 1 800 282-8069, extension 5580.

Use the *Packing List* to confirm that all materials have been received. Count the shrink-wrapped test booklets to ensure that there are enough booklets for the number of students writing the test. Keep the shrink-wrapped test packages unopened until the morning of the test. If additional test materials are needed, immediately contact Ray Novog, Administrative Officer at the number noted above.

Store test materials in a secure area in the school.

Provide supervising teachers with a listing of the Manitoba Education and Youth (MET) numbers for the students registered to write the test. Call the Professional Certification and Student Records Unit at 1 800 667-2378 to obtain MET numbers for new students.

Make arrangements to meet the requirements of the adaptations approved for your students (see Adaptations, page 3 and *Policies and Procedures for Standards Tests*, Sections 4.0, 4.1 and 4.2).

Co-ordinate test scheduling and space requirements.

Minimize the frequency of school announcements during the test session.

Ensure that a replacement supervisor is available to accompany students who must temporarily leave the room.

Provide the test materials to the supervising teacher on the morning of the test.

Complete the *Principal Feedback Form* before the end of the test session.

Advise the Assessment and Evaluation Branch of school closures or suspended school bus transportation services that occur on the test date(s) as a result of unusual or extenuating circumstances or inclement weather conditions. Please contact Neil Vadeboncoeur, Assessment Consultant, at 945-6715 or toll-free at 1 800 282-8069, extension 6715.

# Responsibilities of Supervising Teachers

Supervising teachers administer the test using the step-by-step procedures outlined in the following section ("Checklist of Procedures") in this manual.

## Points to Remember

- Remain in the classroom throughout the entire test session and engage in work solely related to the duties of supervising the test.
- A replacement supervisor must be available to assist you.
- Store all documents not in use in a secure area in the school.
- Ensure that once a booklet number has been assigned to a student, all materials distributed to that student have the same booklet number.
- Students **may** review or complete work from Part 1 during the Part 2 portion of the test session. Students **may not**, however, use their calculator during Part 2 of the session.
- Students **may not** bring anything produced outside of class into the test session.

## Checklist of procedures

| | |
|---|---|
| | **Advance Preparations** |
| | 1. Check with your principal to ensure that: |
| | • appropriate scheduling and space allocation for the test has occurred. |
| | • the test materials itemized on the *Packing List* have been inventoried. |
| | • a replacement supervisor is available to accompany students who must temporarily leave the room during the test. |
| | • arrangements have been made to accommodate the adaptations approved for students. |
| | • a list of MET numbers for students writing the test is available. |
| | 2. Ensure that all subject-related materials have been removed from the walls and boards. |
| | 3. Notify students in advance of the: |
| | • time, location and duration of the test session. |
| | • materials needed to write the test. |
| | • *Test-Taking Rules* (see Appendix 1, p. 17). |
| | • requirement to remain in the test session for the allotted time for Part 1 (60 minutes) and until completion of Part 2. |
| | 4. Ensure that you have extra supplies and that there is a functioning pencil sharpener and stapler in the room. Students must not exchange materials during the test. |
| | 5. If there is more than one teacher supervising the test, photocopy the *Supervising Teacher Report* and *Supervising Teacher Feedback Form*. |
| | 6. Review the sample forms in the Appendices. |
| | **Prior to test session** |
| | 1. Ensure that your materials are available: |
| | • *Packing List*; |
| | • *Senior 4 Pre-Calculus Mathematics (40S) Standards Test* booklets—Part 1 and Part 2; |
| | • *Attendance Forms* (enclosed with shrink-wrapped test booklets); |
| | • *Student Registration Update Form*; |
| | • extra copies of test booklets (four extras); |
| | • *Demographic Data Forms*; |
| | • *Answer/Scoring Sheets*; |
| | • *Supervising Teacher Report*; |
| | • *Supervising Teacher Feedback Form*; |
| | • *Principal Feedback Form* (this must be given to the principal and collected before returning materials); |
| | • *Administration Manual for Supervising Teachers* (this document); |
| | • Xpresspost Flexipack envelope (for schools located outside the city of Winnipeg). |

| | |
|---|---|
| | 2. Count the number of *Senior 4 Pre-Calculus Mathematics (40S) Standards Test* booklets, Part 1 and 2. The number of test booklets should equal the number requested by the school plus the additional booklets. The number of booklets should also be identical to the number on the *Packing List*.<br>If you need to split a bundle of booklets between classrooms, make a photocopy of the *Attendance Form* enclosed with the bundle. **On your copy**, cross out the test booklet numbers that are not used in your classroom and forward these booklets to the supervising teacher who requires them. |
| | 3. Arrange the desks so they are spaced as far apart as possible. |
| | 4. Ensure that students exempted from writing the test are not present. |
| | **Beginning the test session** |
| | 1. Distribute: |
| | • *Senior 4 Pre-Calculus Mathematics (40S) Standards Test* – Part 1. Part 2 is distributed after 60 minutes; |
| | • *Demographic Data Forms*. |
| | 2. Tell students that while they are working you will be circulating the *Attendance Form* so they can print their names beside their test booklet number. |
| | 3. Read instructions for completing *Demographic Data Forms* printed on the top left corner. Direct students to print and shade in all the information requested on the *Demographic Data Form*. Remind students of the importance of accurately recording the program (English, Immersion or Français) they are now in. |
| | 4. Collect the *Demographic Data Forms*. |
| | 5. Read aloud the *Test-Taking Rules* to students (Appendix 1, p. 17). |
| | 6. Read aloud *General Directions* to students (inside the front cover of Part 1 test booklet). |
| | 7. Remind students to: |
| | • pace themselves in writing the test. |
| | • use the *Answer/Scoring Sheet* which will be distributed with Part 2 of the test to record their answers to the selected-response questions. |
| | • check over their work to ensure that all questions have been attempted. |
| | 8. **Instruct students to turn the page and begin. Record the start time for Part 1 on the *Supervising Teacher Report*.** |

| | During the test session |
|---|---|
| | 1. Supervise the completion of the *Attendance Form* by ensuring that students print their name beside their test booklet number. (See sample *Attendance Form*, Appendix 3, p. 19).<br><br>**Note:** This is the only record connecting students' identities to their *Senior 4 Pre-Calculus Mathematics (40S) Standards Test* booklet. |
| | 2. To prepare for the distribution of Part 2 of the test, match-up each Part 2 test booklet with the appropriate numbered *Answer/Scoring Sheet*. You may wish to insert the *Answer/Scoring Sheets* under the inside front cover of the appropriate test booklet. |
| | 3. Half-way through Part 1 of the test session (end of 30 minutes), advise students of the amount of time remaining for Part 1 by writing the remaining time on a board. |
| | 4. Verify that all the information on each *Demographic Data Form* is accurately printed and shaded. Place all used forms in numerical order followed by any unused forms in the labelled envelope provided. **Do not use elastic bands, staples or paper clips on these forms as they may damage the sheets.** Do not seal the envelope. |
| | 5. After 60 minutes, ask the students to place their calculators on the floor for the remainder of the test session. Students retain their Part 1 booklet for the entire testing session. Advise students they may continue working on Part 1 but they may not use their calculators. |
| | 6. Distribute Part 2 of the test and *Answer/Scoring Sheet*, but **before** doing so please note:<br><br>**The booklet numbers for Part 1 and 2 and the number on the *Answer/Scoring Sheet* need to be identical for each student. Advise students that as they receive Part 2 and an *Answer/Scoring Sheet* to verify that these items have the same number as their Part 1 booklet number. Tell students that their answers to the selected-response questions are to be shaded on the back of the *Answer/Scoring Sheet*.** |
| | 7. **Instruct students to turn the page and begin. Record the start time for Part 2 on the *Supervising Teacher Report*.** |
| | 8. Half-way through Part 2 of the test session, advise students of the amount of time remaining by making an announcement and by writing the remaining time on a board. |
| | **Ending the test session** |
| | 1. **Record the time students finish writing the test on the *Supervising Teacher Report*.** Do not include extra time given for adaptations. |
| | 2. Have students place their *Answer/Scoring Sheets* inside the front cover of the test booklet. Collect the test booklets from each student. |
| | 3. As students submit their test materials, ensure that each test booklet number matches the information on the *Answer/Scoring Sheet*, the *Attendance Form* and the *Demographic Data Form* (e.g., cross-reference student name and test booklet number). Each student must have the same booklet number on all test materials. |
| | 4. Place a check "✔" under Part 1 and Part 2 of the *Attendance Form* for booklets submitted, or indicate the reason why a booklet is not submitted for marking (see Appendix 3, p. 19). |
| | 5. Stack the test booklets in numerical order. |

| | |
|---|---|
| | 6. If marking is to be conducted at a central location, place all used *Answer/Scoring Sheets* in numerical order followed by any unused forms. Place these forms in the labelled envelope provided. Do not seal the envelope. |
| | 7. Complete the *Supervising Teacher Report*. Note any unusual circumstances on this report. |
| | 8. Ensure that the number of check marks in the "Booklet Submitted to LMC for Marking" column on the *Attendance Forms* matches your count of the booklets and *Answer/Scoring Sheets* for submission. |
| | 9. Complete and check the *Student Registration Update* form. Use the reason codes (Appendix 4, p. 20) provided. |
| | 10. Make one or two copies of the *Attendance Form(s)* and *Supervising Teacher Report(s)*. One copy must be retained by the school and the other forwarded to the local marking site, if a centralized marking model is used. |
| | 11. Collect the *Principal Feedback Form*. |
| | 12. Complete the *Supervising Teacher Feedback Form*. |
| | 13. Return all test booklets and other test-related materials to the secure area in the school until commencement of marking or until materials are to be forwarded to the local marking site. |
| | 14. Send materials according to the instructions on the following pages. |

## Submitting Materials on January 21, 2003 (the end of the test)

It is essential that the following materials are packaged and forwarded to the local marking site immediately after completion of the test if a centralized model is used.

- **All used** test booklets;
- **All used** *Answer/Scoring Sheets*;
- Copy of the *Attendance Forms*; and
- Copy of the *Supervising Teacher Report*.

All other documentation should be verified and returned to the Assessment and Evaluation Branch after the test session.

- *Attendance Forms*;
- **All used** *Demographic Data Forms* (in envelope provided);
- *Student Registration Update Form*;
- *Supervising Teacher Report*;
- *Supervising Teacher Feedback Form*;
- *Principal Feedback Form*; and
- **All** damaged or misprinted booklets.

**Schools in the City of Winnipeg** return their envelopes to the Assessment and Evaluation Branch in the following way. Mid-Canada Courier is scheduled to pick up envelopes between **1:00 p.m. and 4:00 p.m.** on **January 21, 2003**. If your envelope will not be ready for pick up during these hours, call Mid-Canada Courier (989-5630) to make alternate arrangements.

**Schools outside the City of Winnipeg** return their envelopes to the Assessment and Evaluation Branch by using the Xpresspost Flexipack envelope provided and taking it to the post office.

## Submitting Materials by February 3, 2003 (after local marking)

When local marking is done at a central location, the Local Marking Co-ordinator is responsible for sending the materials to Assessment and Evaluation. When local marking is done at the classroom level, the teacher is responsible for sending the materials to Assessment and Evaluation.

NEW!

After local marking has been completed, prepare a package for return to Assessment and Evaluation no later than February 3, 2003.

The package must include:

- **All** *Answer/Scoring Sheets*;
- Test booklets requested by the department for the feedback marking;
- *Sample Request List*; and
- *Local Marking Co-ordinator Feedback Form*.

**Jurisdictions within the City of Winnipeg** send packages directly to the Assessment and Evaluation Branch via **Mid-Canada Courier (989-5650)**. The person placing the call should quote **account number E901**, give the jurisdiction name, address, and the name of the contact person.

**Jurisdictions outside the City of Winnipeg** return their package by Xpresspost. It is very important to package all materials in the **one Xpresspost Flexipack** envelope provided whenever possible.

After the package is sealed, deliver the package to the local post office.

We have provided sufficient materials for the return of **one** envelope/package. If you must send a second envelope/package, photocopy the mailing address label and affix the copy to the second package. Note that you must use a photocopy of the mailing address label as it provides Canada Post with billing information. Ask the postal clerk for an additional bar code label to attach to the second envelope/package. Ensure that the school representative retains the bar code number in case tracing the package is required.

Return all local marking scan sheets. Payments will be made according to the number of tests marked, based on the local marking scan sheets received.

# Appendices

## Appendix 1: Test-Taking Rules

# Senior 4 Pre-Calculus Mathematics (40S) Standards Test

**The supervising teacher is expected to read these rules aloud to students at the beginning of the *Senior 4 Pre-Calculus Mathematics (40S) Standards Test*:**

- Check the title of your test booklet carefully.
- During this test session, do not proceed until instructed to do so.
- If you receive a damaged or imperfectly printed booklet, return it to receive another booklet.
- You are expected to remain in the test room for the allotted time for Part 1 and until you complete Part 2. (You may leave before that time in exceptional circumstances such as illness, when accompanied by a supervisor.)
- At the beginning of the session you should have only a Part 1 test booklet, an HB pencil, eraser, ruler and your calculator (scientific or graphing, for Part 1 only). No other materials are permitted. Do not exchange test materials. When Part 2 is distributed you will also receive an *Answer/Scoring Sheet* to record your answers to the selected-response questions.
- Your calculator must remain on the floor throughout the administration of Part 2. You may keep your Part 1 booklet for the entire session and and continue working on Part 1 if you wish, but you may not use your calculator.
- You will not give assistance to, nor receive assistance from, another student. If you require something during the test, raise your hand and I will come to you.
- Do not ask questions or request explanations with regard to the content of the questions on the test.
- Do **not** identify yourself or your school, teacher or town/city in your test booklet.
- When I ask you to stop writing, put your pencil down immediately.
- You may not discard any materials. The test booklet must remain intact unless otherwise instructed. Any extra paper used must be stapled into the test booklet on the appropriate page. You may **not** leave the room with any materials pertaining to the test.

# Appendix 2: Sample Demographic Data Form

**SIDE 1**

## DEMOGRAPHIC FORM

Manitoba Education and Training

**INSTRUCTIONS**

- Use an HB pencil only.
- Do not use ink, ballpoint, or felt tip pens.
- Shade the circle completely.
- Erase cleanly any marks you wish to change.
- Do not mark other areas on this form.

**EXAMPLES**

| WRONG | RIGHT |
|---|---|
| Ⓐ ⊗ Ⓒ Ⓓ | Ⓐ Ⓑ Ⓒ ● |
| Ⓐ Ⓑ ⊘ Ⓓ | |
| ◒ Ⓑ Ⓒ Ⓓ | |
| Ⓐ Ⓑ Ⓒ ◔ | |

**PROGRAM INFORMATION**

- Ⓔ English Program
- Ⓘ French Immersion Program
- Ⓕ Français Program

NAME (Last)

NAME (First)

PROVINCIAL STUDENT (MET) NO.

BIRTH DATE

| MONTH | DAY | YEAR |
|---|---|---|
| ○ Jan. | | |
| ○ Feb. | | |
| ○ Mar. | | |
| ○ Apr. | | |
| ○ May | | |
| ○ June | | |
| ○ July | | |
| ○ Aug. | | |
| ○ Sept. | | |
| ○ Oct. | | |
| ○ Nov. | | |
| ○ Dec. | | |

BOOKLET NO.

SCHOOL CODE

GENDER Ⓕ Ⓜ

# Appendix 3: Sample Attendance Form

School Number: 9999
Somewhere School
Somewhere Address
Somewhere MB R0R 0R0

Page _____ of _____

## ATTENDANCE FORM—January 2003

**SENIOR 4 PRE-CALCULUS MATHEMATICS (40S) STANDARDS TEST**

| Booklet Number | Student Name (*Please Print*) | Booklet Submitted to LMC* for Marking (*check* ✓) | |
|---|---|---|---|
| | | Part 1 | Part 2 |
| 30001 | Karen Masi | ✓ | *went home sick* |
| 30002 | Dan Carter | ✓ | ✓ |
| 30003 | Michael Smith | ✓ | ✓ |
| 30004 | DAMAGED | | |
| 30005 | Mary Jones | ✓ | ✓ |
| 30006 | Shelley Bracken (also 30008) | ✓ | ✓ |
| 30007 | UNUSED | | |
| 30008 | Used with 30006 (damaged) | | |
| 30009 | Used in another classroom | | |
| 30010 | Used in another classroom | | |

NOTE: Record any absences on the *Student Registration Update* form.

Myles Kaminsky

**Supervising Teacher's Name** (*please print*)

**Please ensure that copies of these forms are retained for your records. You will need this form to link your locally marked test with a student's name.**

*** Local Marking Co-ordinator**

# Appendix 4: List of Reason Codes to Record Changes in Standards Test Student Registration Numbers

(Please use these codes to complete the *Student Registration Update Form* when returning to the Assessment and Evaluation Branch in January 2003.)

| ABSENT | |
|---|---|
| 01 | arrived too late to write the test |
| 02 | did not write due to weather |
| 03 | family/personal reasons |
| 04 | medical/illness/accident |
| 05 | out-of-town activity (athletic/academic) |
| 06 | religious objections |
| 07 | student refused to write |
| 08 | unexcused |
| 09 | working |
| 19 | other (please specify) |

| WITHDRAWN | |
|---|---|
| 22 | dropped course |
| 23 | incarcerated/court |
| 24 | medical/illness/accident |
| 25 | family/personal reasons |
| 26 | poor attendance/progress |
| 27 | quit school |
| 29 | other (please specify) |

| INCOMPLETE | |
|---|---|
| 40 | continuing course/program next semester |
| 41 | no work completed |
| 49 | other (please specify) |

| ERRORS IN REGISTRATION | |
|---|---|
| 20 | changed program |
| 21 | deceased |
| 50 | already has credit |
| 51 | auditing the course |
| 52 | exchange student |
| 53 | registered twice |
| 54 | quarter system projected registration |
| 55 | registered in wrong grade |
| 59 | other (please specify) |

| EXEMPTIONS | |
|---|---|
| 60 | emotional/psychological condition or circumstances |
| 61 | "M" credit designation |
| 62 | "E" credit designation |
| 63 | "phase d'accueil—bloc intensif" designation |
| 69 | other (please specify) |

| DROP INS | |
|---|---|
| 70 | forgotten on original test registration |
| 71 | late registration to course |
| 72 | transferred in from another school/province/country |
| 73 | rewrite (not currently enrolled) |
| 79 | other (please specify) |

| MIGRANCY | |
|---|---|
| 90 | transferred to another school within the province |
| 91 | transferred to another school outside of the province |
| 99 | other (please specify) |

# Senior 4 Pre-Calculus Mathematics (40S) Standards Test

## Part 1

January 2003

Manitoba
Education
and Youth

# Pre-Calculus Mathematics (40S)
# Standards Test

## DESCRIPTION

**Total Possible Marks: 100** **Time: 3 hours**

| Part | Description | Time | Value |
|---|---|---|---|
| **Part 1** | • **Open Response:** 12 questions worth a total of 35 marks<br>Calculators (scientific or graphing) are permitted. | 60 minutes | 35% |
| **Part 2** | • **Selected Response:** 15 questions worth 1 mark each<br>• **Restricted Response:** 15 questions worth 1 mark each<br>• **Open Response:** 11 questions worth a total of 35 marks<br>Calculators are not permitted. | 120 minutes | 65% |

## GENERAL DIRECTIONS

- Fill in the demographic form accurately and completely.
- Formulas are given on the "Formula Sheet" at the beginning of this test booklet. Please do not tear out any pages other than the "Formula Sheet".
- Read all instructions carefully.
- The blank pages at the back of each booklet may be used for rough work. No marks will be given for work done on these pages.
- Note that the diagrams and graphs provided in the test booklets may not be drawn to scale.
- When Part 2 is distributed, you may keep Part 1 in case you wish to continue working on Part 1 questions (without a calculator).

# Pre-Calculus Mathematics (40S) Formula Sheet

$$S = r\theta$$

$$\sin^2\theta + \cos^2\theta = 1$$

$$\tan^2\theta + 1 = \sec^2\theta$$

$$1 + \cot^2\theta = \csc^2\theta$$

$$\sin(\alpha - \beta) = \sin\alpha\cos\beta - \cos\alpha\sin\beta$$

$$\cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$$

$$\tan(\alpha - \beta) = \frac{\tan\alpha - \tan\beta}{1 + \tan\alpha\tan\beta}$$

$$\sin(\alpha + \beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta$$

$$\cos(\alpha + \beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$$

$$\tan(\alpha + \beta) = \frac{\tan\alpha + \tan\beta}{1 - \tan\alpha\tan\beta}$$

$$\sin 2\alpha = 2\sin\alpha\cos\alpha$$

$$\cos 2\alpha = \cos^2\alpha - \sin^2\alpha = 1 - 2\sin^2\alpha = 2\cos^2\alpha - 1$$

$$\tan 2\alpha = \frac{2\tan\alpha}{1 - \tan^2\alpha}$$

$$P(n,r) \text{ or } {}_nP_r = \frac{n!}{(n-r)!}$$

$$C(n,r) \text{ or } {}_nC_r = \frac{n!}{r!(n-r)!}$$

$$t_{k+1} = {}_nC_k a^{n-k} b^k$$

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

$$A = Pe^{rt}$$

$$e \approx 2.71828$$

$$\log_a(MN) = \log_a M + \log_a N$$

$$\log_a\left(\frac{M}{N}\right) = \log_a M - \log_a N$$

$$\log_a(M^n) = n\log_a M$$

$$\log_a M = \frac{\log_b M}{\log_b a}$$

$$(x-h)^2 + (y-k)^2 = r^2$$

$$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1, \quad a > b$$

$$\frac{(x-h)^2}{b^2} + \frac{(y-k)^2}{a^2} = 1, \quad a > b$$

$$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$$

$$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$$

$$(y-k) = a(x-h)^2$$

$$(x-h) = a(y-k)^2$$

$$t_n = t_1 r^{n-1}$$

$$S_n = \frac{t_1(1-r^n)}{1-r} = \frac{t_1(r^n-1)}{r-1}$$

$$S_n = \frac{t_1 - t_n r}{1-r}$$

$$S_\infty = \frac{t_1}{1-r}, \quad |r| < 1$$

# Open-Response Questions

## Instructions

- There are 12 questions for a total of 35 marks.
- Calculators (scientific or graphing) are allowed for this part of the test.
- Write each solution in the space provided.
- For full marks, your answers must show all pertinent diagrams, calculations, and explanations.
- Graphing calculator solutions should include an explanation of how your final answer is obtained.
- Your solutions should be neat, organized and clear.
- If any curve contains asymptotes, the asymptotes should be included in the graph.

DO NOT USE

## Open-Response Questions

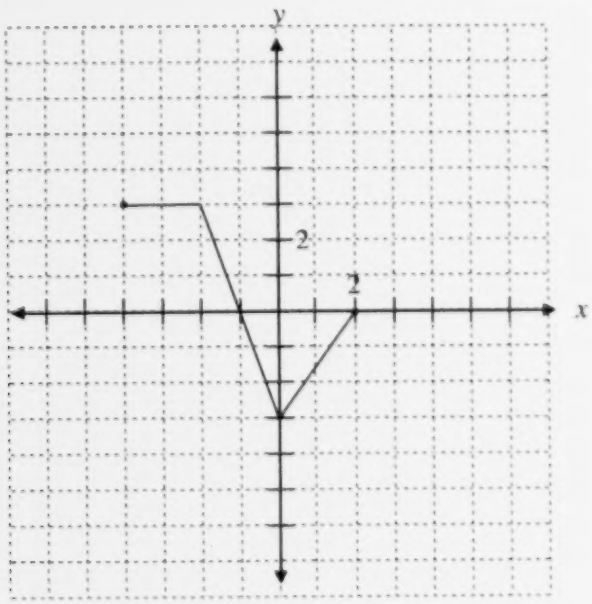
1. The graph of a function $y = f(x)$ is shown below. In the spaces provided, draw the graphs of:

a) $y = |f(x)|$ 101

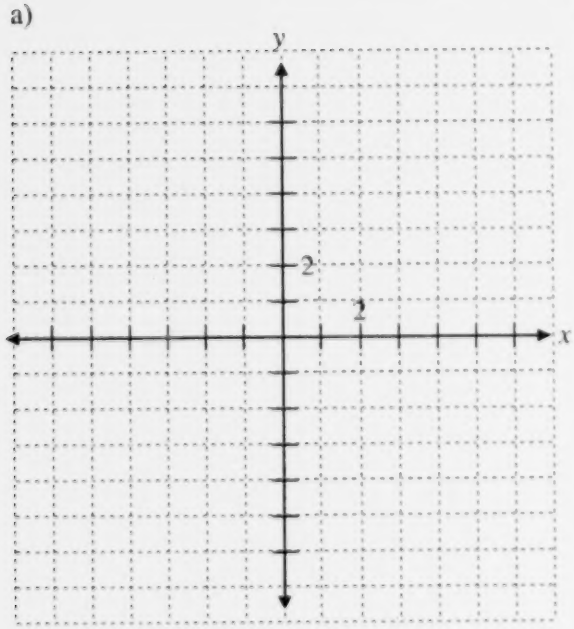
(1 mark)

b) $y = -f(x-3)$ 102

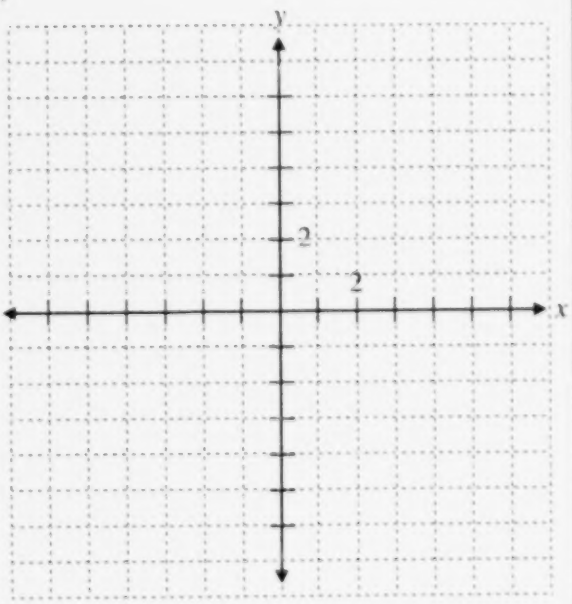
(2 marks)




a)




b)



DO NOT USE

2. Solve for $x$ in the interval $[0, 2\pi]$. 103
State your solution(s) with the exact value(s) or correct to 3 decimal places.

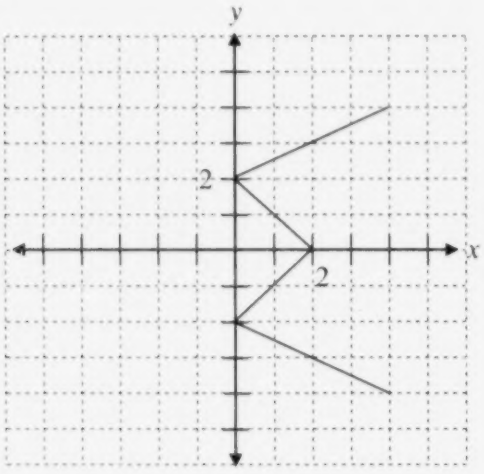
$$3\sin 2x + \cos x = 0$$

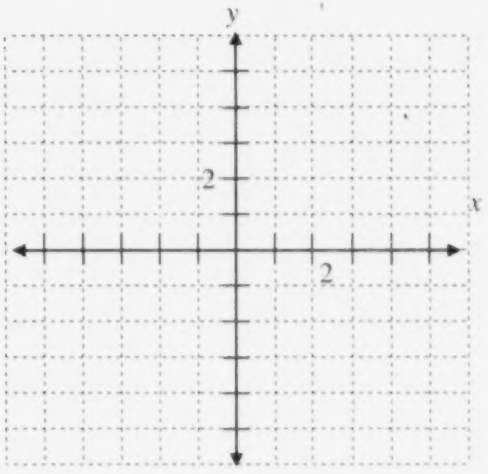
(4 marks)

104

3. The graph of the inverse of a function is shown below.
In the space provided, draw the graph of the original function $y = f(x)$.

(2 marks)



DO NOT USE

4. Solve for $x$:

$$\log_2(x-2)-\log_2 x=3$$

105

(3 marks)

106

5. A circle has a radius of 12 cm.
Find the length of the arc which is intercepted by a central angle of 100°.
Give your answer to one decimal place.

(2 marks)

DO NOT USE

6. The lights are left on when a car is parked. The battery discharges and the voltage, $V$ volts, of the battery is given at any time by: $V = V_o\ e^{-kt}$ 107
$V_o = 12$ volts, $k = 0.01$ and $t$ is measured in minutes.
Find, to the nearest minute, the time it takes for the battery charge to reduce to 9 volts.

(3 marks)

7. The equation of a conic section is:

$$y^2 - 4x + 2y - 15 = 0$$

a) Find the $y$-intercept(s). 108

(1 mark)

b) Find the coordinates of the vertex/vertices. 109

(2 marks)

DO NOT USE

8. In a class there are 15 boys and 10 girls.
A sample of 5 students is to be selected to represent this class.
In how many ways can this be done? 110

(2 marks)

9. The fourth term of a geometric sequence is 108 and the seventh term is 23 328.
Find the first three terms of this sequence. 111

(4 marks)

DO NOT USE

10. Consider the numbers between 100 and 400.
How many of these numbers are even and have no repetition of digits?

112

(3 marks)

11. Consider the expansion of $\left(2x^3 - \frac{1}{x}\right)^{15}$.

Determine if there is a term, in simplified form, containing $x^{30}$ in this expansion.
Explain your answer.

113

(2 marks)

DO NOT USE

114

12. Jeremy gets a ride to school every Monday.
On each of the other four days he walks to school.
When he gets a ride, he is late 5% of the time.
When he walks to school, he is late 10% of the time.
On a certain day last week Jeremy was late.
Find the probability that he walked to school that day.

(4 marks)

**NO MARKS WILL BE AWARDED FOR WORK DONE ON THIS PAGE**

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**NO MARKS WILL BE AWARDED FOR WORK DONE ON THIS PAGE**

# Senior 4 Pre-Calculus Mathematics (40S) Standards Test

## Part 2

January 2003

Manitoba
Education
and Youth

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Manitoba Education and Youth,
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Winnipeg, Manitoba R3E 3J5.

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# Selected-Response Questions

## Instructions

- There are 15 selected-response questions.
- Each question is worth 1 mark.
- Record your answers on the *Answer/Scoring Sheet* provided.
- Read each question carefully.
- Examine all the choices before you decide on your answer.
- You may use the spaces beside each question for rough work.
- Answer all questions.
- Provide only one answer per question.
- There is no penalty for guessing.
- Calculators (scientific or graphing) are NOT allowed for this part of the test.

## Selected-Response Questions

13. An angle of $400^\circ$ is drawn in standard position. If the terminal side rotates through $\frac{\pi}{2}$ radians, the new angle terminates in quadrant:

a) I

b) II

c) III

d) IV

14. If $\sec x = 3$ then an exact value for $\tan x$ is:

a) $\frac{1}{\sqrt{10}}$

b) $\frac{1}{2\sqrt{2}}$

c) $2\sqrt{2}$

d) $\sqrt{10}$

15. A zero of the function $f(x) = 2\cos x - 1$ is:

a) 0

b) $\frac{\pi}{6}$

c) $\frac{\pi}{3}$

d) $\frac{\pi}{2}$

16. Which of the following expressions is equivalent to:

$$x = \frac{\pi}{4} + k\pi,\ k \in I$$

a) $x = \frac{\pi}{4},\quad x = \frac{5\pi}{4}$

b) $x = \frac{5\pi}{4} + k\pi,\ k \in I$

c) $x = \frac{5\pi}{4} + 2k\pi,\ k \in I$

d) $x = \frac{\pi}{4} + 2k\pi,\ k \in I$

17. The expression $(\sin x + \cos x)^2 - 1$ is equivalent to:

a) $\sin x \ \cos x$

b) $2\sin x$

c) $\sin 2x$

d) 0

18. If the point $(a, b)$ lies on the graph of a function $y = f(x)$, then a point which lies on the graph of the function $y = 2f(x+3)$ is:

a) $(a-3,\ 2b)$

b) $\left(a-3,\ \frac{b}{2}\right)$

c) $\left(a+3,\ \frac{b}{2}\right)$

d) $(a+3,\ 2b)$

19. Given the function $f(x) = x^2 - 2x - 3$, an equation of a vertical asymptote of the graph of $y = \dfrac{1}{f(x)}$ is:

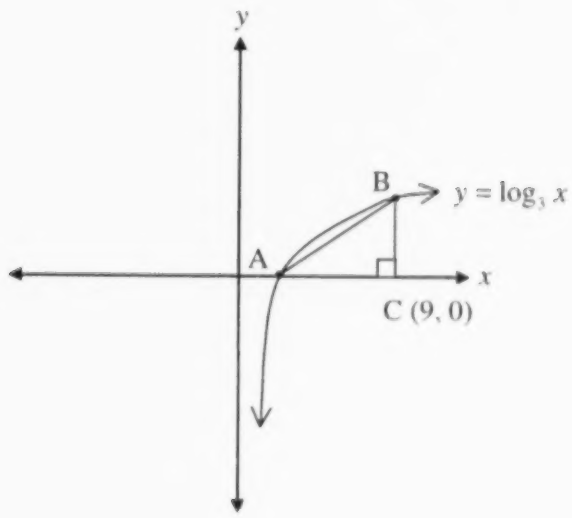
a) $x = -3$

b) $x = 0$

c) $x = 1$

d) $x = 3$

20.




The above graph represents the function $y = \log_3 x$.
If the coordinates of C are (9, 0) then the area of $\Delta ABC$ is:

a) 8 units$^2$

b) 9 units$^2$

c) 12 units$^2$

d) $\dfrac{27}{2}$ units$^2$

21. If $\log 24 = 3\log a + \log b$ then possible values for $a$ and $b$ are:

a) $a = 2 \qquad b = 18$

b) $a = 1 \qquad b = 8$

c) $a = 2 \qquad b = 3$

d) $a = 4 \qquad b = 2$

22. The sum of an infinite geometric series is 12. If the common ratio is $\frac{1}{3}$, then the first term is:

a) 36

b) 18

c) 8

d) 4

23. In how many ways can six students be seated in a row if three of these students insist on sitting together?

a) 24

b) 36

c) 72

d) 144

24. Samantha has eight candies all different in colour. She wants to divide them equally between herself and her friend Julie. In how many ways can this be done?

a) ${}_8C_4$

b) ${}_8C_4 \times 2$

c) $4! \times 4!$

d) ${}_8C_4 \times {}_8C_4$

25. Two five-sided dice (numbered 1 to 5) are thrown together. The probability that the sum is 8 is:

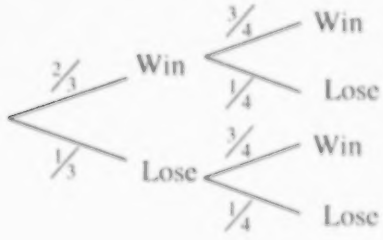
a) $\frac{2}{25}$

b) $\frac{3}{25}$

c) $\frac{2}{5}$

d) $\frac{3}{5}$

26. Jim plays two different games in succession. The probability of winning each game is shown on the tree diagram below.




Find the probability that he wins **at least** one game.

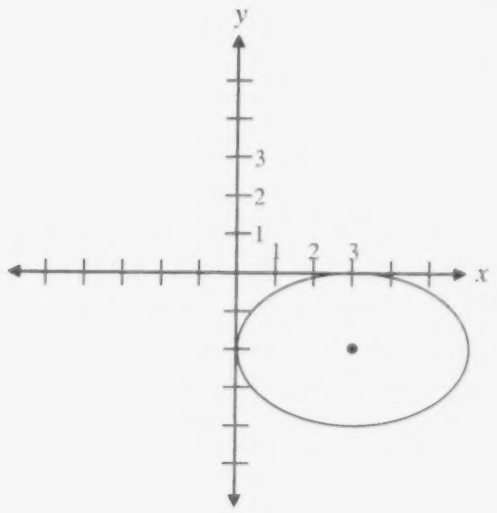
a) $\frac{1}{2}$

b) $\frac{2}{3}$

c) $\frac{3}{4}$

d) $\frac{11}{12}$

27.




A possible equation for the conic section whose graph is shown above is:

a) $\frac{(x+3)^2}{36}+\frac{(y-2)^2}{16}=1$

b) $\frac{(x+3)^2}{9}+\frac{(y-2)^2}{4}=1$

c) $\frac{(x-3)^2}{9}+\frac{(y+2)^2}{4}=1$

d) $\frac{(x-3)^2}{3}+\frac{(y+2)^2}{2}=1$

# Restricted-Response Questions

## Instructions

- There are 15 restricted-response questions.
- Each question is worth 1 mark.
- Calculators are NOT allowed for this part of the test.
- Write your final answer in the space provided.
- Work need not be shown in order to obtain full marks for a correct answer. However, in the case of an incorrect final answer, part marks may be awarded only if work is shown.

DO NOT USE

## Restricted-Response Questions

28. The hands of a clock show a time of 9:10 a.m. If the minute hand rotates through an angle of $\frac{7\pi}{3}$ radians in a clockwise direction, find the new time shown by the clock. 115

(1 mark)

29. The point $P(\theta)$ lies on the intersection of the unit circle and the line segment joining the origin to the point (–3, 4). Find the coordinates of $P(\theta)$. 116

(1 mark)

30. Find the exact value of: 117

(1 mark)

$$\cos\frac{7\pi}{12}\cos\frac{\pi}{12} + \sin\frac{7\pi}{12}\sin\frac{\pi}{12}$$

DO NOT USE

31. Given $f(x)=6\cos\left[\frac{\pi}{2}(x+2)\right]$. Evaluate $f(8)$. 118

(1 mark)

32. Describe all transformations to be carried out on the graph of $y=f(x)$ in order to obtain the graph of $y=3f(x-1)$. 119

(1 mark)

33. The function $y=3\sin\left(\frac{\pi}{4}x\right)-1$ has a maximum point at (10, 2). 120

Find the coordinates of the next maximum point on the graph.

(1 mark)

DO NOT USE

34. State the domain of the function:
$f(x) = \log_3(x+2)$.

121

(1 mark)

35. Solve for $x$ in terms of $a$ and $b$:
$e^x = a^b$

122

(1 mark)

36. Consider the function: $y = 8^x - 2$.
Find the $x$-intercept of this function.

123

(1 mark)

DO NO
USE

37. If $\log_x 125 = 3$, find the exact value of $x$.

124

(1 mark)

38. Find the first term in the expansion of $(2-x)^5$.

125

(1 mark)

39. The probability that Anne hits a target is 0.4. What is the probability that she misses the target?

126

(1 mark)

DO NOT USE

40. The probability that Claudette will pass mathematics is $\frac{5}{7}$. 127

The probability that she will pass chemistry is $\frac{2}{3}$.

Find the probability that Claudette passes both mathematics and chemistry.

(1 mark)

41. Simplify: $\frac{n!}{(n+1)!}$ 128

(1 mark)

42. Find the equations of the asymptotes of the hyperbola: 129

$$\frac{x^2}{9} - \frac{y^2}{4} = 1$$

(1 mark)

# Open-Response Questions

## Instructions

- There are 11 questions worth a total of 35 marks.
- Calculators are NOT allowed for this part of the test.
- Write each solution in the space provided.
- For full marks, your answers must show all pertinent diagrams, calculations, and explanations.
- Your solutions should be neat, organized and clear.
- If any curve contains asymptotes, the asymptotes should be included in the graph.

DO NOT USE

43. Find the simplest exact value of:

130

$$\cot\frac{7\pi}{6} - \tan\frac{\pi}{6} - \sec\frac{\pi}{6}$$

(3 marks)

44. Find an exact value for:

131

$$\cos 105°$$

(4 marks)

DO NOT USE

132

45. Prove the identity:

$$\frac{\cos^2 x}{\sin x - \sin^2 x} = 1 + \csc x$$

(4 marks)

DO NOT USE

46. Find the area of the circle whose equation is: 133

$$x^2 + y^2 + 4x - 96 = 0$$

(2 marks)

47. Four boys and three girls are to be seated in a row.
The boys and girls sit in alternate positions.

a) How many seating arrangements are possible if Suney, one of the four boys, must be seated at the right end of the row? 134

(2 marks)

b) How many seating arrangements are possible if Suney does not sit at the right end of the row? 135

(1 mark)

DO NO
USE

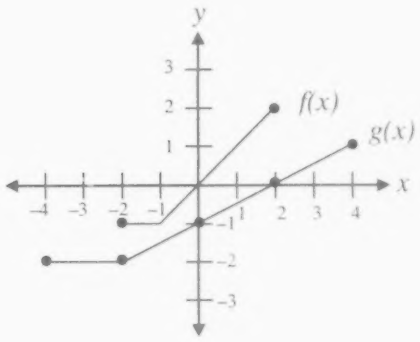
136

48. A bag contains 5 red balls and 10 yellow balls.
Two balls are drawn at random from the bag without replacement.
Find the probability that both balls are the same colour.

(3 marks)

49. Using transformations express $g(x)$ in terms of $f$.

(2 marks)

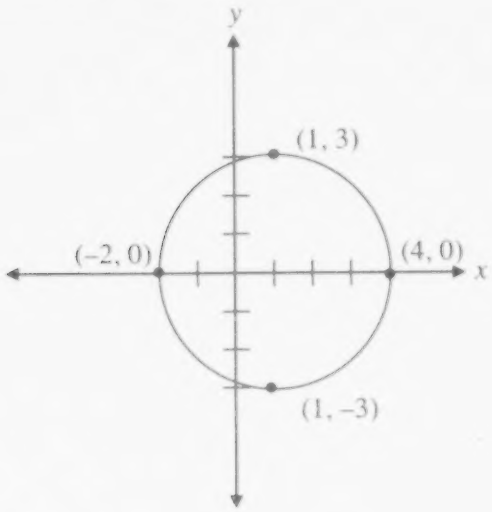



$g(x) =$ _____

137

DO NOT USE

50. A circle is pictured below.




a) State the equation of the circle. 138

(1 mark)

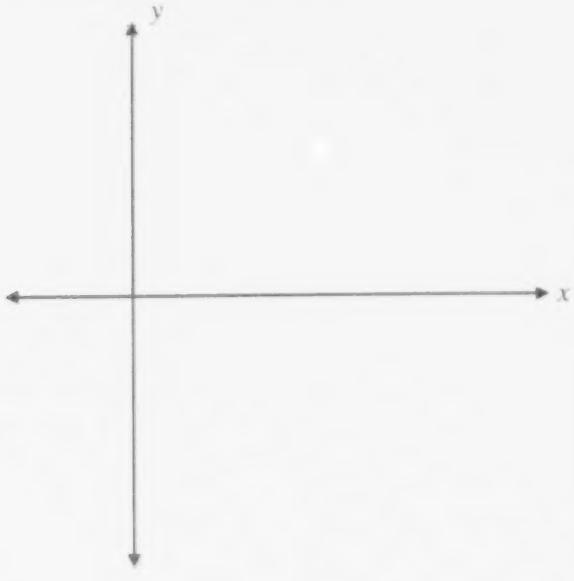
b) Stretch the above circle vertically by a factor of 2. Find an equation of the resulting graph. 139

(2 marks)

DO NOT USE

51. a) On the axes provided, sketch a clearly labeled graph of the function $y = \csc x$ in the interval $[0, 2\pi]$. Include any asymptotes and/or intercepts which exist. 140

(2 marks)




b) On the above axes, draw the graph of the equation $y = 2$. Find the $x$-coordinates of the point(s) of intersection of these graphs in the interval $[0, 2\pi]$. 141

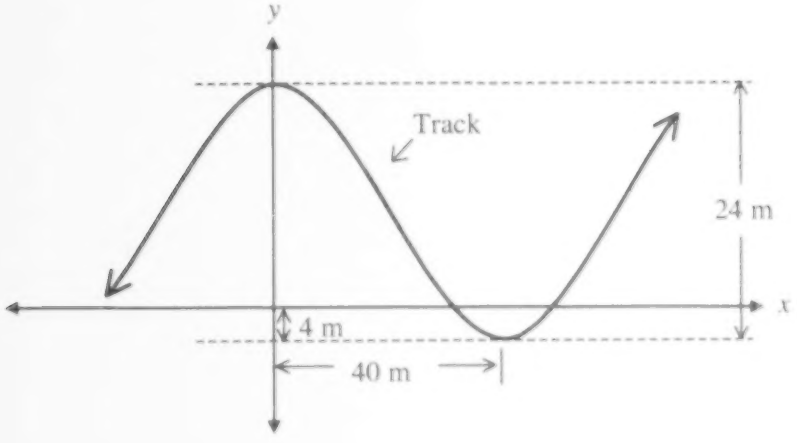
(2 marks)

DO NOT USE

52. A portion of a roller coaster track is built in the shape of a sinusoidal curve as shown below.
Find an equation to represent this curve.

142

(3 marks)



DO NO
USE

53. Positive numbers $a$, $b$ and $c$, are consecutive terms in a geometric sequence.

143

a) Show that: $b = \sqrt{ac}$

(2 marks)

b) If $b = 10$, show that $\log a + \log c = 2$

144

(2 marks)

**NO MARKS WILL BE AWARDED FOR WORK DONE ON THIS PAGE**

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# Senior 4 Pre-Calculus Mathematics (40S) Standards Test

# Marking Guide

January 2003

Manitoba
Education
and Youth

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Part 2: Restricted-Response Questions ..... 37

Part 2: Open-Response Questions ..... 53

# General Marking Instructions

**Please make no marks in the *Student Response Booklets*.**

Please ensure that:

- the student test booklet number and the number on this sheet are identical;
- **only a pencil is used to complete the *Answer/Scoring Sheets*, by both students and markers**;
- the totals of each of the four parts are written at the bottom;
- each student's final result is recorded, by test booklet number, on the corresponding ***Answer/Scoring Sheet*** (computer scan sheet);
- the grand total is written in the appropriate location;
- the *Answer/Scoring Sheet* is complete; and
- a photocopy has been made for school records.

Once marking is completed, please forward the ***Answer/Scoring Sheets*** to Manitoba Education and Youth (for more information see the *Administration Manual for Supervising Teachers*.

## Scoring the Selected-Response Questions

Please follow the instructions on the ***Answer Key for Selected-Response Questions*** on page 5.

## Scoring the Restricted-Response and Open-Response Questions

The remainder of Senior 4 Pre-calculus Mathematics Standards Test is composed of Restricted-Response questions and open-response questions. Restricted-response questions are worth 1 mark each and open-response questions are worth 2 to 4 marks each.

Each question is designed to elicit a well-defined response according to the associated specific learning outcome(s) and relevant mathematical processes. Their purpose is to determine whether a student meets the standards for the course as they relate to the knowledge and skills associated with the question.

To receive full marks, a student's response must be complete and correct. Otherwise, 1 mark must be deducted for each concept error, and ½ mark must be deducted for a calculation or arithmetic error. Where alternative answering methods are possible, the *Marking Key* attempts to address the most common solutions.

## Assistance

If, during marking, any marking issue arises that cannot be resolved locally, please call Manitoba Education and Youth at the earliest opportunity to advise and/or seek assistance. If required, we will connect you to an advisor. Also, please be sure to notify us before making any modifications to the answer keys or scoring rubrics. Contact person: Neil Vadeboncoeur at 945-6715 (1 800 282-8069, extension 6715).

# SCORING GUIDELINES

## *Answer Key for Selected-Response Questions*

# Answer Key for Selected-Response Questions

If you are using this sheet by punching out holes corresponding to the correct answers and overlaying this sheet on the *Answer/Scoring Sheet*, then

1) check the student's responses for multiple bubbles first (questions with multiple bubbles are to be scored as "0");

2) overlay this page on the *Answer/Scoring Sheet*; and

3) count the number of correct responses, excluding questions with multiple responses, if any.

Remember to write the total score for the selected-response questions at the bottom of the *Answer/Scoring Sheet*.

**SELECTED-RESPONSE QUESTIONS / QUESTIONS À RÉPONSE CHOISIE**

**Fill in the best answer for each question. / Choisir la meilleure réponse pour chaque question.**

| | | | | | |
|---|---|---|---|---|---|
| 13 | Ⓐ●ⓒⓓ | 18 | ●ⓑⓒⓓ | 23 | ⒶⒷⓒ● |
| 14 | ⒶⒷ●ⓓ | 19 | ⒶⒷⓒ● | 24 | ●Ⓑⓒⓓ |
| 15 | ⒶⒷ●ⓓ | 20 | ●ⓑⓒⓓ | 25 | Ⓐ●ⓒⓓ |
| 16 | Ⓐ●ⓒⓓ | 21 | ⒶⒷ●ⓓ | 26 | ⒶⒷⓒ● |
| 17 | ⒶⒷ●ⓓ | 22 | ⒶⒷ●ⓓ | 27 | ⒶⒷ●ⓓ |

| Selected-Response | | | |
|---|---|---|---|
| *Question* | *Outcome* | *Question* | *Outcome* |
| 13 | A1 | 21 | D5 |
| 14 | A2; C1 | 22 | H3 |
| 15 | A6 | 23 | E1 |
| 16 | A5 | 24 | E3 |
| 17 | C1; C2 | 25 | G2 |
| 18 | B1; B2 | 26 | G5 |
| 19 | B4 | 27 | F3 |
| 20 | D4 | | |

# SCORING GUIDELINES

## *Marking Key*
## including student exemplars

# Part 1—Open-Response

## Question No. 1

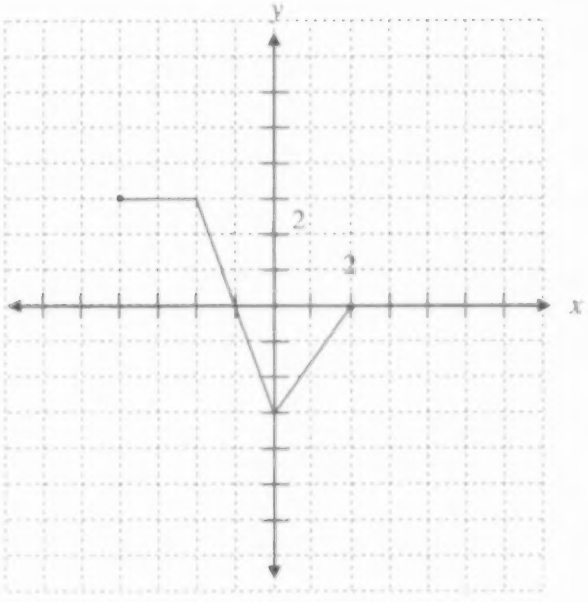
**Outcome: A1**

### Question

1. The graph of a function $y = f(x)$ is shown below. In the spaces provided, draw the graph of:

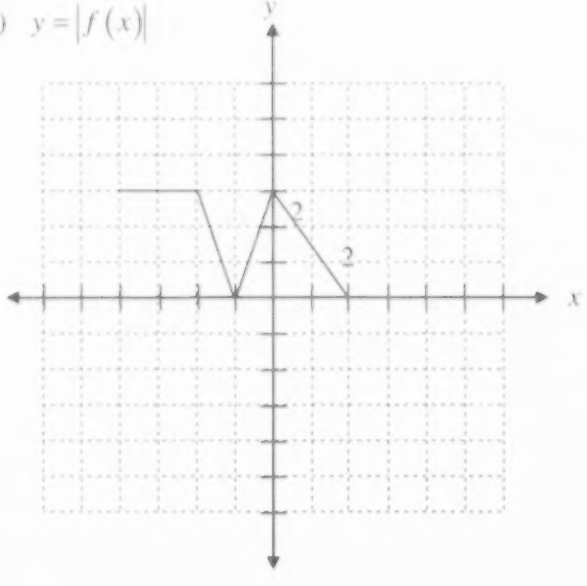
   a) $y = |f(x)|$

1 mark




### Solution

a) $y = |f(x)|$




1 mark for correct graph

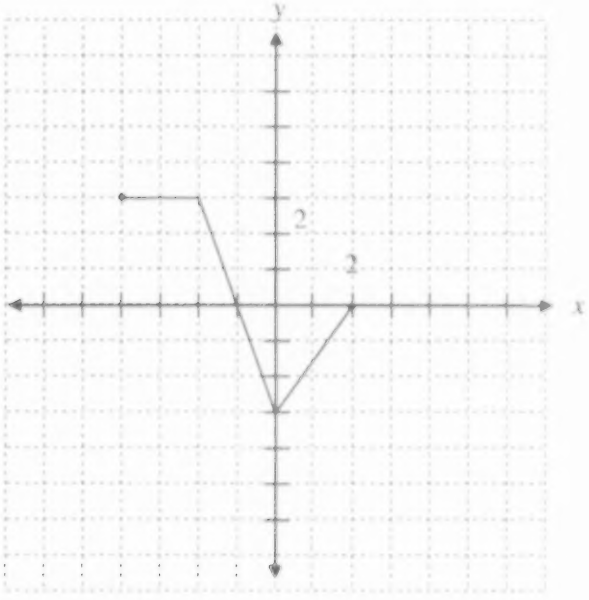
# Question No. 1

**Outcome: A1**

## Question

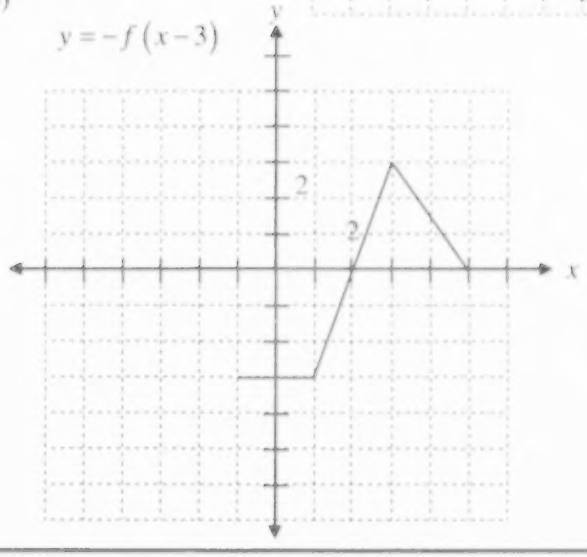
1. The graph of a function $y = f(x)$ is shown below. In the spaces provided, draw the graph of:
   b) $y = -f(x-3)$

2 marks




## Solution

b)




2 marks
- 1 mark for reflection in $x$-axis
- 1 mark for horizontal translation

## Note(s)

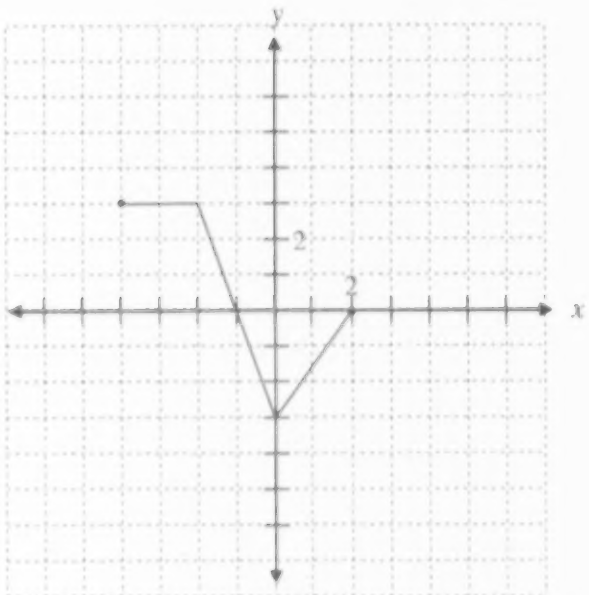
- (a) give ½ mark if entire graph is drawn above $x$-axis and at most 2 vertices are incorrect.

# EXEMPLARS

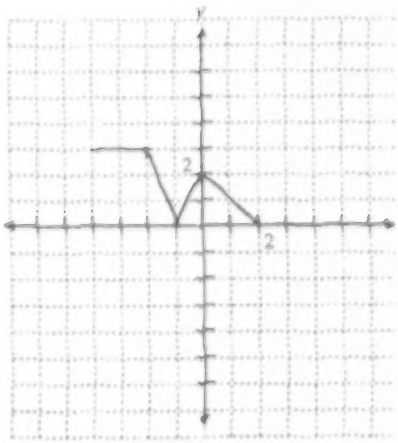
1. The graph of a function $y = f(x)$ is shown below. In the spaces provided, draw the graphs of:

   a) $y = |f(x)|$

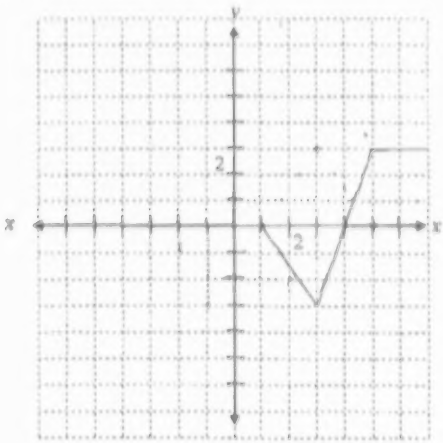
   b) $y = -f(x-3)$




a)




b)




**a) Mark:** ½ **out of 1**
**Note(s):** • wrong *y*-intercept

**b) Mark:** **1 out of 2**
**Note(s):** • correct shift but wrong reflection

# Question No. 2

**Outcome: A4, C2**

## Question

2. Solve for $x$ in the interval $[0, 2\pi]$.
   State your solution(s) with exact value(s) or correct to 3 decimal places.

4 marks

$$3\sin 2x + \cos x = 0$$

## Solution

$6\sin x\cos x + \cos x = 0$ — 1 mark

$\cos x(6\sin x + 1) = 0$ — ½ mark

$\cos x = 0 \quad \sin x = -\frac{1}{6}$ — ½ mark

$x = \frac{\pi}{2}; \frac{3\pi}{2}; 3.309; 6.116$

OR

$x = 1.571; 4.712; 3.309; 6.116$

} 2 marks (½ mark for each answer)

# EXEMPLARS

2. Solve for $x$ in the interval $[0, 2\pi]$.
   State your answer with exact values or correct to 3 decimal places.

$$3\sin 2x + \cos x = 0$$

$6 \sin x \cos x + \cos x = 0$

$6 \sin x + 1 = 0$

$\sin x = -\frac{1}{6}$

$x = 3.309$ or $x = 6.116$

**Mark:** **2 out of 4**
**Note(s):** • deduct 2 marks for dividing by cos $x$ and losing 2 solutions

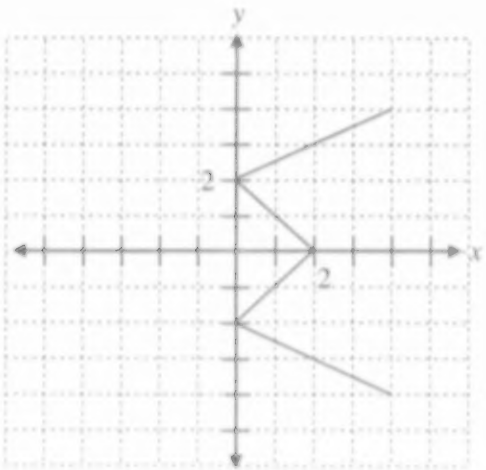
# Question No. 3

**Outcome: B3**

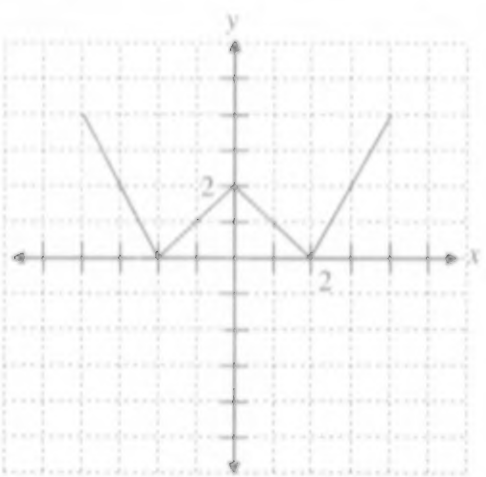
## Question

3. The graph of the inverse of a function is shown below.
   In the space provided, draw the graph of the original function $y = f(x)$.

2 marks




## Solution




2 marks (½ mark for each segment)

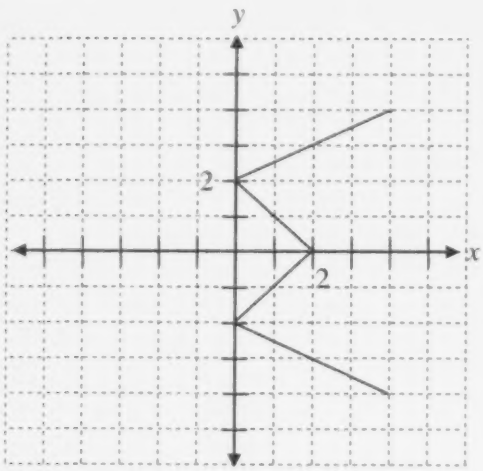
## Note(s)

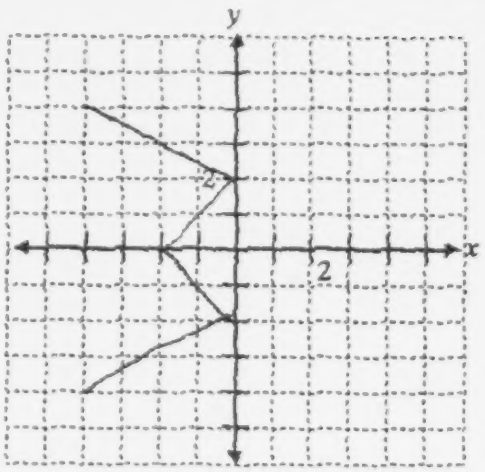
- 0 marks given for a reflection over the y-axis

# EXEMPLARS

3. The graph of the inverse of a function is shown below.
   In the space provided, draw the graph of the original function $y = f(x)$.

(2 marks)




**Mark:** **0 out of 2**

**Note(s):** • reflection over the $y$-axis

# Question No. 4

**Outcome: D6**

## Question

4. Solve for $x$: $\log_2(x-2)-\log_2 x=3$

3 marks

## Solution

$\log_2(x-2)-\log_2 x=3$

$\log_2\dfrac{x-2}{x}=3$ — 1 mark for log theorem

$\dfrac{x-2}{x}=8$ — 1 mark for change to exponential form

$x-2=8x$

$-\dfrac{2}{7}=x$ — ½ mark for solving for $x$

NO SOLUTION — ½ mark for statement or equivalent form of rejection

# EXEMPLARS

4. Solve for $x$: $\log_2(x-2)-\log_2 x=3$

$$\log_2(x-2) - \log_2 x = 3$$

$$\log_2\left(\frac{x-2}{x}\right) = 3$$

$$2^3 = \frac{x-2}{x}$$

$$8x = x-2$$

$$8x - x = 2$$

$$x(8-1) = 2$$

$$x = \frac{2}{7}$$

| | |
|---|---|
| **Mark:** | **2 out of 3** |
| **Note(s):** | • arithmetic error, no rejection |

# Question No. 5

**Outcome: A2**

## Question

5. A circle has a radius of 12 cm.
   Find the length of the arc which is intercepted by a central angle of 100°.
   Give your answer to one decimal place.

2 marks

## Solution

$\theta = 100° \cdot \frac{\pi}{180°}$ — 1 mark for conversion

$S = 12\left(\frac{5\pi}{9}\right)$ — ½ mark for substitution into $S = r\theta$

$S = 20.9$ cm — ½ mark for consistent answer

OR

$C = 2\pi r$
$= 24\pi$ } 1 mark for circumference

$S = 24\pi\left(\frac{100}{360}\right)$ — ½ mark for substitution

$= 20.9$ cm — ½ mark for consistent answer

## Note(s)

- ½ mark deduction for missing units
- ½ mark deduction for incorrect rounding
- 100° = 1.745 radians

} maximum ½ mark deducted for both errors

# EXEMPLARS

5. A circle has a radius of 12 cm.
   Find the length of the arc which is intercepted by a central angle of 100°.
   Give your answer to one decimal place.

$s = \theta \cdot r$

$s = 100\ (12)$

$= 1200.0$ cm.

**Mark:** **1 out of 2**
**Note(s):** • deduction of 1 mark for no conversion into radians

# Question No. 6

**Outcome: D8**

## Question

6. The lights are left on when a car is parked. The battery discharges and the voltage, $V$ volts, of the battery is given at any time by: $V = V_o\ e^{-kt}$
$V_o = 12$ volts, $k = 0.01$ and $t$ is measured in minutes.
Find, to the nearest minute, the time it takes for the battery charge to reduce to 9 volts.

## Solution

3 marks

### Method 1

| | |
|---|---|
| $V = V_o\ e^{-kt}$ | |
| $9 = 12\ e^{-0.01t}$ | ½ mark for substitution of values |
| $0.75 = e^{-0.01t}$ | ½ mark for simplification |
| $\ln 0.75 = -0.01t\ \cancel{\ln e}$ | 1 mark for logarithms or correct change to log form |
| $\frac{\ln 0.75}{-0.01} = t$ | ½ mark for isolating $t$ |
| $t = 29$ minutes | ½ mark for consistent answer |

### Method 2

$$9 = 12e^{-0.01t}$$
$$0.75 = e^{-0.01t}$$
$$\log 0.75 = -0.01t \log e$$
$$\frac{\log 0.75}{-0.01 \log e} = t$$
$$t = 29 \text{ minutes}$$

# Question No. 6

**Outcome: D8**

## Question

6. The lights are left on when a car is parked. The battery discharges and the voltage, $V$ volts, of the battery is given at any time by: $V = V_o\ e^{-kt}$
   $V_o = 12$ volts, $k = 0.01$ and $t$ is measured in minutes.
   Find, to the nearest minute, the time it takes for the battery charge to reduce to 9 volts.

## Solution

3 marks

**Method 3**

$e^{-k} = e^{-0.01} = 0.99005$

$V = V_0(0.99005)^t$ ½ mark for substitution

$9 = 12(0.99005)^t$ ½ mark for substitution

$0.75 = (0.99005)^t$

$\ln 0.75 = t(\ln 0.99005)$ } 1 mark for logarithms or correct change to log form

$t = \dfrac{\ln 0.75}{\ln(0.99005)}$ ½ mark for isolating $t$

$t = 29$ minutes ½ mark for consistent answer

## Note(s)

- No marks deducted for omitting "minutes"

# EXEMPLARS

6. The lights are left on when a car is parked. The battery discharges and the voltage, $V$ volts, of the battery is given at any time by: $V = V_o\ e^{-kt}$
   $V_o = 12$ volts, $k = 0.01$ and $t$ is measured in minutes.
   Find, to the nearest minute, the time it takes for the battery charge to reduce to 9 volts.

$9 = 12e^{0.01 \cdot t}$

$\frac{\ln 9}{\ln 12} = \ln e^{0.01 \cdot t}$

$\frac{0.8842}{0.01} = \frac{0.01 \cdot t}{0.01}$

$88.42 = t$

| | |
|---|---|
| **Mark:** | **0 out of 3** |
| **Note(s):** | • incorrect use of log theorems |

# Question No. 7

**Outcome: H1**

## Question

7. The equation of a conic section is:
   $y^2 - 4x + 2y - 15 = 0$
   a) Find the $y$-intercept(s). — 1 mark
   b) Find the coordinates of the vertex/vertices. — 2 marks

## Solution

### Method 1

a) $y$-intercepts: $\rightarrow x = 0$

$y^2 + 2y - 15 = 0$ — ½ mark for substituting $x = 0$

$(y-3)(y+5) = 0$

$y = 3 \qquad y = -5$ — ½ mark for solving and stating intercepts correctly

b) $(y^2 + 2y + 1) - 1 - 4x - 15 = 0$

$(y+1)^2 - 1 - 4x - 15 = 0$

$(y+1)^2 = 4x + 16$ — 1 mark for completing the square

$(y+1)^2 = 4(x+4)$ — ½ mark for taking out the common factor

Vertex = (–4, –1) — ½ mark for stating vertex consistent with work shown

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### Method 2

a) same as Method 1

b) $y$ at vertex $= \dfrac{3+(-5)}{2} = -1$

$(-1)^2 - 4x + 2(-1) - 15 = 0$

$1 - 4x - 2 - 15 = 0$

$-4x = 16$ — 1 mark for method

$x = -4$ — ½ mark for correct value of $x$

vertex (–4, –1) — ½ mark for stating vertex

# Question No. 7

**Outcome: H1**

## Question

7. The equation of a conic section is:
   $y^2 - 4x + 2y - 15 = 0$
   a) Find the $y$-intercept(s). — 1 mark
   b) Find the coordinates of the vertex/vertices. — 2 marks

## Solution

**Method 3**

a) same as Method 1

b) $\frac{y^2}{4} + \frac{2y}{4} + \frac{-15}{4} = \frac{4x}{4}$

$y-$value at vertex $= \frac{-b}{2a}$

$\frac{-.5}{2\left(\frac{1}{4}\right)} = -1$

} 1 mark for method

$\therefore x$ value at vertex is

$(-1)^2 - 4x + 2(-1) - 15 = 0$

$1 - 2 - 15 = 4x$

$-16 = 4x$

$-4 = x$

} ½ mark for correct value of $x$

$\therefore$ vertex $(-4, -1)$ — ½ mark for stating vertex

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**Method 4** (Graphing Calculator)

$y^2 + 2y - 15 = 4x$

$\frac{y^2 + 2y - 15}{4} = x$

graph inverse $y = \frac{\left(x^2 + 2x - 15\right)}{4}$

1 mark for method

a) $x$-intercepts are $-5$, 3 so $y$-intercepts of given relation are $-5$, 3 — 1 mark

b) find minimum $(-1, -4)$ so vertex of given relation is $(-4, -1)$

1 mark for final answer

# EXEMPLARS

7. The equation of a conic is:
$y^2 - 4x + 2y - 15 = 0$

a) Find the y-intercept(s).

$y^2 + 2y = 4x + 15$
$y^2 + 2y - 15 = 4(0)$
$(y+5)(y-3) = 0$
y-intercepts : $(0, -5), (0, +3)$

**Mark:** ½ out of 1
**Note(s):** • y-intercept form is incorrect

b) Find the coordinates of the vertex/vertices.

$y^2 + 2y = 4x + 15$
$y^2 + 2y + 4 = 4x + 19$
$(y+2)^2 = 4x + 19$
$\frac{(y+2)^2}{4} = x + \frac{19}{4}$
$a(y-k)^2 = (x-h)^2$, vertex @ $(h, k)$
vertex at $(-\frac{19}{4}, -2)$

**Mark:** 1 out of 2
**Note(s):** • completing the square is incorrect

# Question No. 8

**Outcome: E2**

## Question

8. In a class there are 15 boys and 10 girls.
   A sample of 5 students is to be selected to represent this class.
   In how many ways can this be done?

2 marks

## Solution

### Method 1

No. of ways $= {}_{25}C_5$ — 1 mark for combination

$= 53\,130$ — 1 mark for consistent answer

### Method 2

${}_{15}C_5 + {}_{15}C_4 \cdot {}_{10}C_1 + {}_{15}C_3 \cdot {}_{10}C_2 + {}_{15}C_2 \cdot {}_{10}C_3 + {}_{15}C_1 \cdot {}_{10}C_4 + {}_{10}C_5 = 53\,130$ — 2 marks

**deduct** ½ mark for each missing team

## Note(s)

- 1 mark for permutation ${}_{25}P_5 = 6\,375\,600$
- 1 mark for ${}_{15}C_5 + {}_{10}C_5 = 3255$
- No marks for any other incorrect answer

# EXEMPLARS

8. In a class there are 15 boys and 10 girls.
   A sample of 5 students is to be selected to represent this class.
   In how many ways can this be done?

Total: 15+10=25
want 5

$_{25}C_5 = 53130$

$5! = 120$

$_{25}C_5 \cdot 5!$

$= 53130 \cdot 120$

$= 6375600$ ways

| | |
|---|---|
| **Mark:** | **1 out of 2** |
| **Note(s):** | • correct permutation |

# Question No. 9

**Outcome: E3**

## Question

9. The fourth term of a geometric sequence is 108 and the seventh term is 23 328.
   Find the first three terms of this sequence.

4 marks

## Solution

### Method 1

$t_7 = t_1 r^6 = 23328$ — ½ mark for $t_7$

$t_4 = t_1 r^3 = 108$ — ½ mark for $t_4$

$\dfrac{t_1 r^6}{t_1 r^3} = \dfrac{23328}{108}$ — 1 mark for determining $r^3$

} or — 2 marks for the correct setup of ratio equation for determining $r^3$

$r^3 = 216$

$r = 6$ — ½ mark for solving for $r$

$t_1 \cdot 6^3 = 108$

$t_1 = \dfrac{1}{2}$

GP is ½, 3, 18, . . . — 1½ marks for answer (½ mark for each term)

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### Method 2

____, ____, ____, 108, ____, ____, 23328

new sequence:

$t_4 = 23328$

$t_1 = 108$

$23328 = 108r^3$

$216 = r^3$

} 2 marks for setup of ratio equation for determining $r^3$

$6 = r$ — ½ mark for solving for $r$

sequence: ½, 3, 18 — 1½ marks for answer (½ mark for each)

# EXEMPLARS

9. The fourth term of a geometric sequence is 108 and the seventh term is 23 328. Find the first three terms of this sequence.

$\underset{t_4}{108}$ ___ ___ $\underset{t_7}{23328}$

$t_n = t_1 r^{n-1}$

$t_4 = t_1 r^3$

$108 = t_1 r^3$

$t_7 = t_1 r^6$

$23328 = t_1 r^6$

$\frac{108}{t_1} = r^3$

$\sqrt[3]{\frac{108}{t_1}} = r$

$23328 = t_1 \left(\sqrt[3]{\frac{108}{t_1}}\right)^6$

$23328 = t_1 \left(\frac{108}{t_1}\right)^3$

**Mark:** **1½ out of 4**

**Note(s):** • ½ mark for each equation and ½ mark for eliminating "$r$"

# Question No. 10

**Outcome: E4**

## Question

10. Consider the numbers between 100 and 400.
How many of these numbers are even and have no repetition of digits?

3 marks

## Solution

**Method 1**

Case 1: $\underset{\textcircled{1}}{1} \times \underset{}{8} \times \underset{\textcircled{E}}{5} = 40$

Case 2: $\underset{\textcircled{2}}{1} \times \underset{}{8} \times \underset{\textcircled{E}}{4} = 32$

Case 3: $\underset{\textcircled{3}}{1} \times \underset{}{8} \times \underset{\textcircled{E}}{5} = 40$

1 mark for identification of cases
1 mark for calculation of cases

Total = 40 + 32 + 40
= 112

1 mark for correct answer

**Method 2**

all : $\underset{1,\,2,\,3}{3} \quad \underset{}{8} \quad \underset{0,\,2,\,4,\,6,\,8}{5} = 120$ 1 mark

overlap : $\underset{\textcircled{2}}{1} \quad \underset{}{8} \quad \underset{\textcircled{2}}{1} = 8$ 1 mark

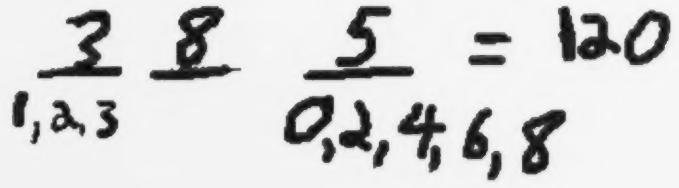
all – overlap = 112 1 mark

## Note(s)

- Case 1 and Case 3 of Method 1 may be combined

# EXEMPLARS

10. Consider the numbers between 100 and 400.
How many of these numbers are even and have no repetition of digits?
Justify your calculations.




| | |
|---|---|
| **Mark:** | **1 out of 3** |
| **Note(s):** | • step 1 of method 2 |

# Question No. 11

**Outcome: G4**

## Question

11. Consider the expansion of $\left(2x^3 - \frac{1}{x}\right)^{15}$.

Determine if there is a term, in simplified form, containing $x^{30}$ in this expansion.
Explain your answer.

2 marks

## Solution

$t_1 = \text{——}x^{45}$
$t_2 = \text{——}x^{41}$
$t_3 = \text{——}x^{37}$
etc...

} 1 mark for explanation/justification

$\therefore$ There is no term in $x^{30}$ as 30 is not a term of the sequence: 45, 41, 37, . . . 1 mark for statement (consistent with work shown)

OR

${}_{15}C_r\left(2x^3\right)^{15-r}\left(-\frac{1}{x}\right)^r$ is a term in the sequence

$\left(x^3\right)^{15-r} \cdot \frac{1}{x^r} = x^{30}$
$\frac{x^{45-3r}}{x^r} = x^{30}$
$45 - 4r = 30$
$-4r = -15$
$r = \frac{15}{4}$

} 1 mark

Since $r$ is not a whole number there is no such term. 1 mark for statement

## Note(s)

- 0 marks if only the statement is given

# EXEMPLARS

11. Consider the expansion of $\left(2x^3 - \frac{1}{x}\right)^{15}$.

Determine if there is a term, in simplified form, containing $x^{30}$ in this expansion. Explain your answer.

$\binom{15}{r}(2x^3)^{15-r}\left(-\frac{1}{x}\right)^r \rightarrow \binom{15}{r}(2x^3)^{15-r}(-x^{-1})^r$

$x^{30} = x^{45} + x^{-3r} - x^{-r}$

$x^{30} = x^{45} + x^{-4r}$

$x^{-15} = x^{-4r}$

$-15 = -4r$

$3.75 = r$

There is not a term containing $x^{30}$ in this expansion since r does not equal a whole number (r must be a positive integer).

**Mark:** **1 out of 2**
**Note(s):** • concept error

# Question No. 12

**Outcome: G4**

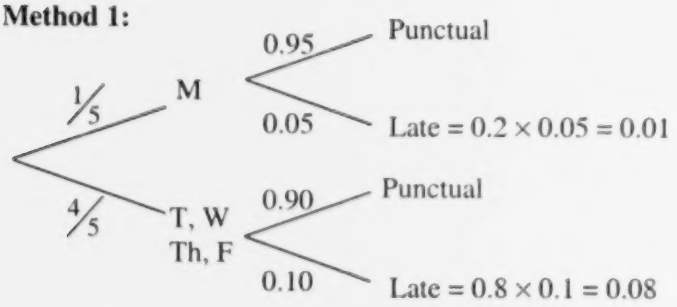
## Question

12. Jeremy gets a ride to school every Monday.
On each of the other four days he walks to school.
When he gets a ride, he is late 5% of the time.
When he walks to school, he is late 10% of the time.
On a certain day last week Jeremy was late.
Find the probability that he walked to school that day.

4 marks

## Solution

**Method 1:**




1 mark for calculation

1 mark for calculation

$$P(\text{Walked}|\text{Late}) = \frac{0.08}{0.01+0.08}$$ 1 mark for probability setup

$$= \frac{0.08}{0.09}$$

$$= \frac{8}{9}$$ 1 mark for consistent answer

**Method 2:**

$$P(\text{ride and late}) = \left(\frac{1}{5}\right)(0.05) = 0.01$$ 1 mark for calculation

$$P(\text{walk and late}) = \left(\frac{4}{5}\right)(0.1) = 0.08$$ 1 mark for calculation

$$P(\text{walk}|\text{late}) = \frac{0.08}{0.08+0.01}$$ 1 mark for probability setup

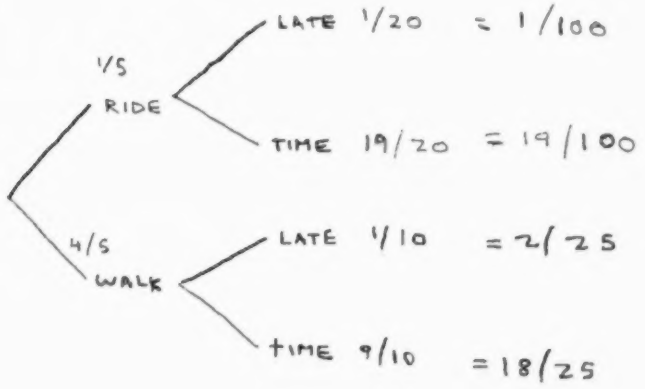
$$= 0.\overline{8}$$ 1 mark for consistent answer

## Note(s)

- give 1 mark if only a correctly labelled tree diagram is supplied

# EXEMPLARS

12. Jeremy gets a ride to school every Monday.
On each of the other four days he walks to school.
When he gets a ride, he is late 5% of the time.
When he walks to school, he is late 10% of the time.
On a certain day last week Jeremy was late.
Find the probability that he walked to school that day.




$P(B|A) = \frac{P(A+B)}{P(A)}$

B = walked
A = late

$= \frac{2/25}{1/10}$ (= .8)

**Mark:** **3 out of 4**
**Note(s):** • incorrect denominator

# Part 2—Restricted-Response

## Question No. 28

**Outcome: A1**

### Question

28. The hands of a clock show a time of 9:10 a.m. If the minute hand rotates through an angle of $\frac{7\pi}{3}$ radians in a clockwise direction, find the new time shown by the clock.

1 mark

### Answer

**Method 1:**

$\frac{7\pi}{3}$ rad. $= \frac{7}{3} \times \frac{1}{2}$ revolutions

$= \frac{7}{6}$ revolutions

} ½ mark for conversion to revolutions

$=$ 1 hour 10 min

New time = 10 : 20 a.m.

} ½ mark for new time on clock

**Method 2:**

$\frac{7\pi}{3} = 2\pi + \frac{\pi}{3}$

$\downarrow \quad \downarrow$

1 hour + $\frac{1}{6}$ of an hour (10 minutes)

} ½ mark for separation of angle or amount of time

New time = 10:20 a.m. ½ mark for new time on clock

# Question No. 29

**Outcome: A1**

## Question

29. The point $P(\theta)$ lies on the intersection of the unit circle and the line segment joining the origin to the point (–3, 4). Find the coordinates of $P(\theta)$.

1 mark

## Answer

$x^2 + y^2 = r^2$

$(-3)^2 + (4)^2 = r^2$

$5 = r$ ½ mark for solving for $r$

$P(\theta) = \left(\frac{-3}{5}, \frac{4}{5}\right)$ ½ mark for consistent answer

# Question No. 30

**Outcome: A3, C2**

## Question

30. Find the exact value of:

$$\cos\frac{7\pi}{12}\cos\frac{\pi}{12} + \sin\frac{7\pi}{12}\sin\frac{\pi}{12}$$

1 mark

## Answer

$$\cos\frac{7\pi}{12}\cos\frac{\pi}{12} + \sin\frac{7\pi}{12}\sin\frac{\pi}{12}$$

$$= \cos\left(\frac{7\pi}{12} - \frac{\pi}{12}\right)$$

$$= \cos\frac{\pi}{2}$$

$$= 0$$

## Note(s)

- give ½ mark if answer is correctly simplified to $\cos\left(\frac{7\pi}{12} - \frac{\pi}{12}\right)$ or $\cos\frac{6\pi}{12}$ or $\cos\frac{\pi}{2}$

# Question No. 31

**Outcome: A6**

## Question

31. Given $f(x)=6\cos\left[\frac{\pi}{2}(x+2)\right]$. Evaluate $f(8)$.

1 mark

## Answer

$$f(x)=6\cos\left[\frac{\pi}{2}(x+2)\right]$$

$$f(8)=6\cos\left[\frac{\pi}{2}(10)\right]$$

$$=6\cos 5\pi$$

$$=6(-1)$$

$$=-6$$

## Note(s)

- give ½ mark for substitution of 8 for $x$

# Question No. 32

**Outcome: B6**

## Question

32. Describe all transformations to be carried out on the graph of $y = f(x)$ in order to obtain the graph of $y = 3f(x-1)$.

1 mark

## Answer

Vertical stretch by a factor of 3

Horizontal translation of 1 unit to the right

## Note(s)

- give ½ mark for each correctly described transformation
- order of transformations is **not** important on this question

# Question No. 33

**Outcome: B7**

## Question

33. The function $y = 3\sin\left(\frac{\pi}{4}x\right) - 1$ has a maximum point at (10, 2).

Find the coordinates of the next maximum point on the graph.

1 mark

## Answer

Period = $\frac{2\pi}{\pi/4} = 8$

Next maximum = (2, 2) OR (18, 2)

## Note(s)

- give ½ mark for correct period
- give ½ mark for answer consistent with period
- give ½ mark for an answer of 2 or 18

# Question No. 34

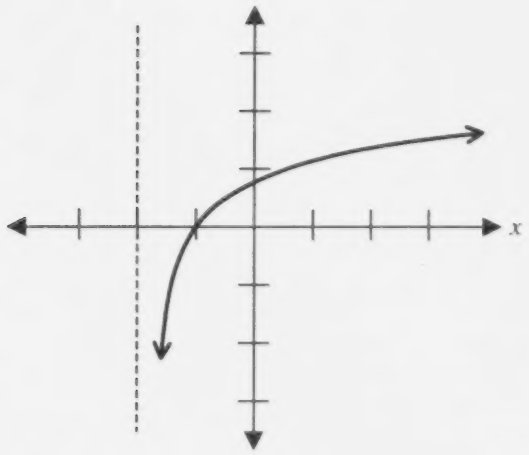
**Outcome: B1, D4**

## Question

34. State the domain of the function:
$f(x)=\log_3(x+2)$

1 mark

## Answer




Domain = $(-2, \infty)$ OR $x > -2$

## Note(s)

- graph is not required
- give ½ mark for $[-2,\infty)$ OR $-2 < x \leq \infty$ OR $x \geq -2$
- 0 marks given for an answer based on an incorrect graph

# Question No. 35

**Outcome: D7**

## Question

35. Solve for $x$ in terms of $a$ and $b$:
$e^x = a^b$

1 mark

## Answer

$\ln e^x = \ln a^b$

$x \cancel{\ln e} = (b)\ln a$ OR $x \log e = (b)\log a$

$x = (b)\ln a$ OR $\ln a^b$ OR $x = \dfrac{(b)\log a}{\log e}$

OR

$$x = \frac{(b)\ln a}{\ln e}$$

## Note(s)

- give ½ mark for $\ln e^x = \ln a^b$ or $\log e^x = \log a^b$

# Question No. 36

**Outcome: D2**

## Question

36. Consider the function: $y = 8^x - 2$.
Find the $x$-intercept of this function.

1 mark

## Answer

### Method 1

$x$-intercepts → $y = 0$

$$8^x - 2 = 0$$
$$8^x = 2$$
$$\left(2^3\right)^x = 2^1$$
$$3x = 1$$
$$x = \frac{1}{3}$$

### Method 2

$$8^x = 2$$
$$\log 8^x = \log 2$$
$$x \log 8 = \log 2$$
$$x = \frac{\log 2}{\log 8} \quad \text{OR} \quad x = \frac{\ln 2}{\ln 8} \quad \text{OR} \quad x = \log_8 2$$

## Note(s)

- give ½ mark for substitution of $y = 0$
- **deduct** ½ mark if answer is stated as $\left(\frac{1}{3}, 0\right)$

# Question No. 37

**Outcome: D3**

## Question

37. If $\log_x 125 = 3$, find the exact value of $x$.

1 mark

## Answer

$x^3 = 125$

$x = \sqrt[3]{125}$ OR $x = 5$

## Note(s)

- give ½ mark for change to exponential form $x^3 = 125$

# Question No. 38

**Outcome: E4**

## Question

38. Find the first term in the expansion of $(2-x)^5$.

1 mark

## Answer

$1^{st}$ term $= 2^5$

$= 32$

## Note(s)

- give full mark for final answer of $2^5$
- give ½ mark if term is identified as $2^5$ and incorrectly evaluated
- no marks for $-x^5$

# Question No. 39

**Outcome: G2**

## Question

39. The probability that Anne hits a target is 0.4. What is the probability that she misses the target?

1 mark

## Answer

$P = 1 - .4$
$P = .6$

# Question No. 40

**Outcome: G3**

## Question

40. The probability that Claudette will pass mathematics is $\frac{5}{7}$.

    The probability that she will pass chemistry is $\frac{2}{3}$

    Find the probability that Claudette passes both mathematics and chemistry.

1 mark

## Answer

$$\frac{2}{3} \cdot \frac{5}{7} = \frac{10}{21}$$

## Note(s)

- **deduct** ½ mark for arithmetic error

# Question No. 41

**Outcome: E1**

## Question

41. Simplify: $\dfrac{n!}{(n+1)!}$

1 mark

## Answer

$$\frac{n!}{(n+1)!} = \frac{n!}{(n+1)n!} = \frac{1}{(n+1)}$$

## Note(s)

- give ½ mark for changing $(n+1)!$ to $(n+1)n!$

# Question No. 42

**Outcome: F3**

## Question

42. Find the equations of the asymptotes of the hyperbola:

$$\frac{x^2}{9} - \frac{y^2}{4} = 1$$

1 mark

## Answer

Equations are:

$$\frac{x^2}{9} - \frac{y^2}{4} = 0$$

OR

$$\frac{x}{3} = \pm\frac{y}{2}$$

OR

$$\begin{cases} 2x - 3y = 0 \\ 2x + 3y = 0 \end{cases}$$

OR

$$y = \pm\frac{2}{3}x$$

## Note(s)

- give ½ mark for one correct equation

# Part 2—Open-Response

## Question No. 43

**Outcome: A4, C2**

### Question

43. Find the simplest exact value of:

$$\cot\frac{7\pi}{6} - \tan\frac{\pi}{6} - \sec\frac{\pi}{6}$$

3 marks

### Solution

$$\cot\frac{7\pi}{6} - \tan\frac{\pi}{6} - \sec\frac{\pi}{6}$$

$$= \sqrt{3} - \frac{1}{\sqrt{3}} - \frac{2}{\sqrt{3}}$$

- 1 mark for $\cot\frac{7\pi}{6}$
- 1 mark for $\sec\frac{\pi}{6}$
- ½ mark for $\tan\frac{\pi}{6}$

$$= \frac{3-1-2}{\sqrt{3}}$$

$$= 0$$

½ mark for simplification

# EXEMPLARS

43. Find the simplest exact value of:

$$\cot\frac{7\pi}{6} - \tan\frac{\pi}{6} - \sec\frac{\pi}{6}.$$

$\tan\frac{\pi}{6}$ is positive
$\sec\frac{\pi}{6}$ is positive
$\cot\frac{\pi}{6}$ is positive

$$\cot\frac{7\pi}{6} = \frac{1}{\tan\frac{7\pi}{6}} = \frac{1}{\frac{\sqrt{3}}{3}} = \frac{3}{\sqrt{3}} = \frac{3\sqrt{3}}{3}$$

$$\tan\frac{\pi}{6} = \frac{\sqrt{3}}{3}$$

$$\sec\frac{\pi}{6} = \frac{1}{\cos\frac{\pi}{6}} = \frac{1}{\frac{\sqrt{3}}{2}} = \frac{2}{\sqrt{3}} = \frac{2\sqrt{3}}{3}$$

$$\cot\frac{7\pi}{6} - \tan\frac{\pi}{6} - \sec\frac{\pi}{6} = \frac{3\sqrt{3}}{3} - \frac{\sqrt{3}}{3} - \frac{2\sqrt{3}}{3} = 0$$

$$\cot\frac{7\pi}{6} = \left(\frac{-\sqrt{3}}{2} \cdot \frac{2}{1}\right) = \frac{2\sqrt{3}}{2}$$

$$\tan\frac{\pi}{6}\left(\frac{1}{2} \cdot \frac{2}{\sqrt{3}}\right) = \frac{2\sqrt{3}}{6}$$

$$\sec\frac{\pi}{6} = \left(\frac{2\sqrt{3}}{6} \cdot \frac{2}{\sqrt{3}}\right) = \frac{4\sqrt{3}}{6\sqrt{3}} = \frac{2}{3}$$

$$= \frac{2\sqrt{3}}{2} - \frac{2\sqrt{3}}{6} - \frac{2}{3}$$

**Mark:** 2½ out of 3

**Note(s):** • deduct ½ mark for incorrectly stating $\sec\frac{\pi}{6} = \frac{2}{3}$

# Question No. 44

**Outcome: C2**

## Question

44. Find the exact value for:

$$\cos 105°$$

4 marks

## Solution

### Method 1

$\cos 105°$ or $\cos\left(\frac{7\pi}{12}\right)$

$= \cos(45° + 60°)$ or $\cos\left(\frac{\pi}{4} + \frac{\pi}{3}\right)$ — 1 mark for any correct combination

$= \cos 45° \cos 60° - \sin 45° \sin 60°$ — ½ mark for correct identity

$= \frac{\sqrt{2}}{2} \times \frac{1}{2} - \frac{\sqrt{2}}{2} \times \frac{\sqrt{3}}{2}$ — 2 marks for correct function values (½ mark for each function value)

$= \frac{\sqrt{2} - \sqrt{6}}{4}$ — ½ mark for consistent answer

---

### Method 2

$\cos(150° - 45°)$ OR $\cos\left(\frac{5\pi}{6} - \frac{\pi}{4}\right)$

$= \cos 150° \cos 45° + \sin 150° \sin 45°$

$= \left(-\frac{\sqrt{3}}{2}\right)\left(\frac{\sqrt{2}}{2}\right) + \left(\frac{1}{2}\right)\left(\frac{\sqrt{2}}{2}\right)$

$= \frac{-\sqrt{6} + \sqrt{2}}{4}$

# EXEMPLARS

44. Find the exact value for:

$\cos 105°$

$\cos 105° = (\text{quad. 2}) = \cos = \text{negative}$, $\sin = \text{positive}$

$105^{\cancel{\circ}}\left(\frac{\pi}{180^{\cancel{\circ}}}\right) = \frac{105\pi}{180} = \frac{7\pi}{12} \rightarrow \underset{\alpha}{\frac{\pi}{3}} + \underset{\beta}{\frac{\pi}{4}} \rightarrow \left(\frac{4\pi}{12} + \frac{3\pi}{12} = \frac{4\pi}{12}\right)$

$\cos(\alpha+\beta) = \cos\left(\frac{\pi}{3}+\frac{\pi}{4}\right) =$

$\cos\frac{\pi}{3}\cos\frac{\pi}{4} - \sin\frac{\pi}{3}\sin\frac{\pi}{4} =$

$\frac{1}{2}\left(\frac{\sqrt{2}}{2}\right) - \frac{\sqrt{3}}{2}\left(\frac{\sqrt{2}}{2}\right) =$

$\frac{\sqrt{2}}{4} - \frac{\sqrt{6}}{4} = \boxed{\frac{\sqrt{2}-\sqrt{6}}{4}}$

| | |
|---|---|
| **Mark:** | **3 out of 4** |
| **Note(s):** | • 2 incorrect function values |

# Question No. 45

**Outcome: C1**

## Question

45. Prove the identity:

4 marks

$$\frac{\cos^2 x}{\sin x - \sin^2 x} = 1 + \csc x$$

## Solution

**Method 1:**

$= \dfrac{1-\sin^2 x}{\sin x - \sin^2 x}$ — 1 mark for substitution of identity

$= \dfrac{(1+\sin x)\cancel{(1-\sin x)}}{\sin x \cancel{(1-\sin x)}}$ — 1 mark for factoring { ½ mark for numerator; ½ mark for denominator }

$= \dfrac{1+\sin x}{\sin x}$ — ½ mark for simplifying

$= \dfrac{1}{\sin x} + \dfrac{\sin x}{\sin x}$ — 1 mark for distribution

$= \csc x + 1$ — ½ mark for final statement

LHS = RHS

---

**Method 2:**

$\text{LHS} = \dfrac{1-\sin^2 x}{\sin x - \sin^2 x}$ — 1 mark for identity

$= \dfrac{(1+\sin x)\cancel{(1-\sin x)}}{\sin x \cancel{(1-\sin x)}}$ — 1 mark for factoring { ½ mark for numerator; ½ mark for denominator }

$= \dfrac{(1+\sin x)}{\sin x}$ — ½ mark for simplifying

LHS = RHS

$\text{RHS} = 1 + \dfrac{1}{\sin x}$ — 1 mark for identity

$= \dfrac{\sin x + 1}{\sin x}$ — ½ mark for combining terms

# EXEMPLARS

45. Prove the identity:

$$\frac{\cos^2 x}{\sin x - \sin^2 x} = 1 + \csc x$$

$$LHS = 1 + \frac{1}{\sin x}$$
$$= \frac{\sin x}{\sin x} + \frac{1}{\sin x}$$
$$= \frac{1 + \sin x}{\sin x}$$

$$RHS = \frac{1 - \sin^2 x}{\sin x - \sin^2 x}$$
$$= \frac{(1 - \sin^2 x)}{\sin x (1 - \sin x)}$$
$$= \frac{(1 + \sin^2 x)}{(1 + \sin x)\sin x}$$
$$= \frac{1 + \sin x}{\sin x}$$

$$\rightarrow LHS = RHS$$

**Mark: 3 out of 4**
**Note(s):** • incorrect simplification

# Question No. 46

**Outcome: F2**

## Question

46. Find the area of the circle whose equation is:

2 marks

$$x^2 + y^2 + 4x - 96 = 0$$

## Solution

$x^2 + y^2 + 4x - 96 = 0$

$(x^2 + 4x \quad) + y^2 = 96$

$(x^2 + 4x + 4) + y^2 = 96 + 4$

$(x+2)^2 + y^2 = 100$

1 mark for completing the square

$r^2 = 100$ ½ mark for $r^2$

area $= \pi r^2$

$= \pi(100)$

$= 100\pi$ units$^2$ ½ mark for area

OR

314 units$^2$

# EXEMPLARS

46. Find the area of the circle whose equation is:

$$x^2 + y^2 + 4x - 96 = 0$$

$(x^2+4x+4) + y^2 = 96 + 4$

$(x+2)^2 + y^2 = 100$ ~~$\pi$~~ $r^2$

area $= 2\pi r^2$

400$\pi$ is the area

**Mark:** 1½ out of 2

**Note(s):** • incorrect formula for the area of a circle

# Question No. 47

**Outcome: B7**

## Question

47. Four boys and three girls are to be seated in a row. The boys and girls sit in alternate positions.

a) How many seating arrangements are possible if Suney, one of the four boys, must be seated at the right end of the row?

2 marks

b) How may seating arrangements are possible if Suney does not sit at the right end of the row?

## Solution

1 mark

**Method 1:**

a) $\frac{3}{B} \times \frac{3}{G} \times \frac{2}{B} \times \frac{2}{G} \times \frac{1}{B} \times \frac{1}{G} \times \frac{1}{B} = 36$

(Suney)

1 mark for counting the arrangements of the three boys and Suney

½ mark for counting the arrangements of the three girls

½ mark for consistent product

b)

$4!\,3! - 36$ ½ mark for $4!\,3!$

$144 - 36 = 108$ ½ mark for subtraction

---

**Method 2:**

a) $3!\ 3!\ 1! = 36$

seat the boys — seat the girls — seat Suney

1 mark for counting the arrangements of the three boys and Suney

½ mark for counting the arrangements of the three girls

½ mark for consistent product

b)

$\underline{3}\ \underline{3}\ \underline{2}\ \underline{2}\ \underline{1}\ \underline{1}\ \underline{3} = 108$

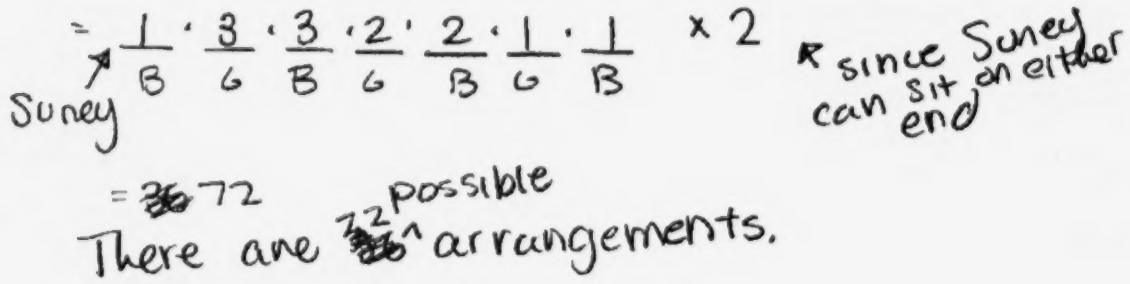
↑

not Suney

# EXEMPLARS

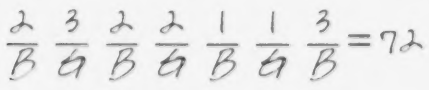
47. Four boys and three girls are to be seated in a row. The boys and girls sit in alternate positions.

a) How many seating arrangements are possible if Suney, one of the four boys, must be seated at the right end of the row?




| | |
|---|---|
| **Mark:** | **1½ out of 2** |
| **Note(s):** | • student has misinterpreted the restriction |

b) How may seating arrangements are possible if Suney does not sit at the right end of the row?




| | |
|---|---|
| **Mark:** | **½ out of 1** |
| **Note(s):** | • student has placed Suney at neither end of the row |

# Question No. 48

**Outcome: D5, H1**

## Question

48. A bag contains 5 red balls and 10 yellow balls. Two balls are drawn at random from the bag without replacement.
Find the probability that both balls are the same colour.

3 marks

## Solution

**Method 1:**

$$P(R+R)=\frac{5}{15}\times\frac{4}{14}=\frac{20}{210}$$ 1 mark for P (R+R)

$$P(Y+Y)=\frac{10}{15}\times\frac{9}{14}=\frac{90}{210}$$ 1 mark for P(Y+Y)

$$P(\text{same colour})=\frac{20}{210}+\frac{90}{210}=\frac{110}{210}$$

OR $\frac{11}{21}$

1 mark { ½ mark for sum; ½ mark for final answer }

**Method 2:**

$$\frac{{}_5C_2+{}_{10}C_2}{{}_{15}C_2}=\frac{\frac{5!}{2!3!}+\frac{10!}{2!8!}}{\frac{15!}{2!13!}}$$

½ mark for ${}_5C_2$
½ mark for ${}_{10}C_2$
1 mark for ${}_{15}C_2$
½ mark for addition of ${}_5C_2+{}_{10}C_2$

$$=\frac{10+45}{105}$$

$$=\frac{55}{105}$$

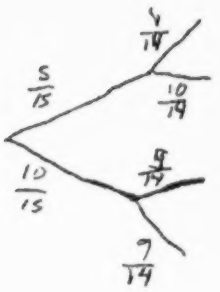
$$=\frac{11}{21}$$

½ mark for final answer (need not be reduced)

# EXEMPLARS

48. A bag contains 5 red balls and 10 yellow balls. Two balls are drawn at random from the bag without replacement.

    Find the probability that both balls are the same colour.




$\frac{5}{15} \cdot \frac{4}{14} = \frac{20}{210}$ $\frac{15}{14}$ $\frac{60}{210}$

$\frac{10}{15} \cdot \frac{9}{14} = \frac{90}{210} = \frac{110}{210}$

| | |
|---|---|
| **Mark:** | **2½ out of 3** |
| **Note(s):** | • incorrect notation |

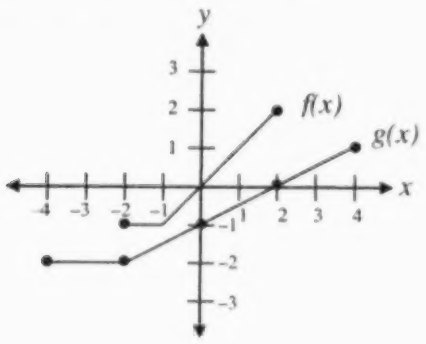
# Question No. 49

**Outcome: B6**

## Question

49. Using transformations express $g(x)$ in terms of $f$.

2 marks




$g(x) =$ _____

## Solution

$g(x) = f\left(\frac{1}{2}x\right) - 1$

1 mark for horizontal stretch

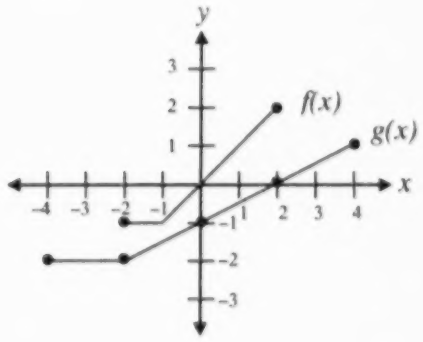
1 mark for vertical translation

## Note(s)

- deduct 1 mark for $g(x) = \frac{1}{2}x - 1$

# EXEMPLARS

49. Using transformations express $g(x)$ in terms of $f$.



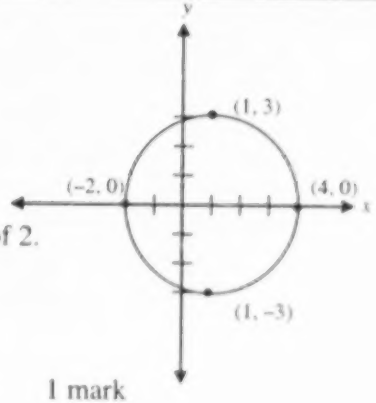

$g(x) =$ $2f\left(\frac{1}{2}x\right)-1$

| | |
|---|---|
| **Mark:** | **1 out of 2** |
| **Note(s):** | • deduct 1 mark for the vertical stretch |

# Question No. 50

**Outcome: G2**

## Question




50. A circle is pictured below.

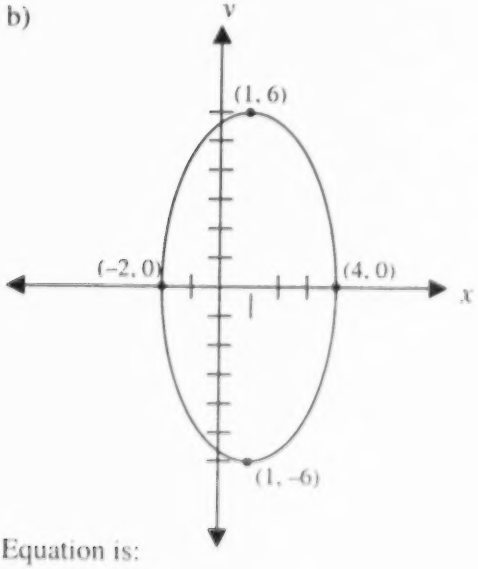
a) State the equation of the circle. — 1 mark

b) Stretch the above circle vertically by a factor of 2. Find an equation of the resulting graph. — 2 marks

## Solution

a) $(x-1)^2 + y^2 = 9$ OR $x^2 + y^2 - 2x - 8 = 0$ 1 mark

b)




Equation is:

$$\frac{(x-1)^2}{9} + \frac{y^2}{36} = 1$$

2 marks (1 mark for each parameter)

OR

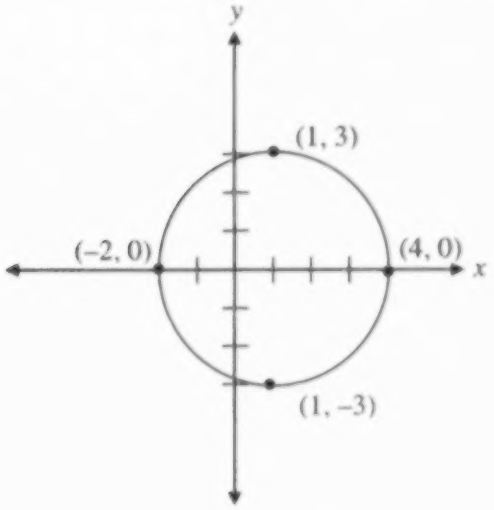
$$(x-1)^2 + \left(\frac{1}{2}y\right)^2 = 9$$ 2 marks

**Note(s):**

- give 0 marks if equation in a) is not an equation of a circle
- give ½ mark in part a) for: $(x+1)^2 + y^2 = 9$ OR $(x-1)^2 + y^2 = 3$

# EXEMPLARS

50. Given the circle pictured below.




a) State the equation of the circle:

$(x-h)^2+(y-k)^2=r^2$

$=(x-1)^2+y^2=36$

| | |
|---|---|
| **Mark:** | **½ out of 1** |
| **Note(s):** | incorrect radius |

b) Stretch the above circle vertically by a factor of 2.
Find an equation of the resulting graph.

all y-values multiplied by 2

$(x-1)^2+2y^2=9$

$\frac{(x-1)^2}{2}+y^2=\frac{9}{2}$

| | |
|---|---|
| **Mark:** | **0 out of 2** |

# Question No. 51

**Outcome: F2**

## Question

51. a) On the axes provided, sketch a clearly labeled graph of the function $y = \csc x$ in the interval $[0, 2\pi]$. Include any asymptotes and/or intercepts which exist.

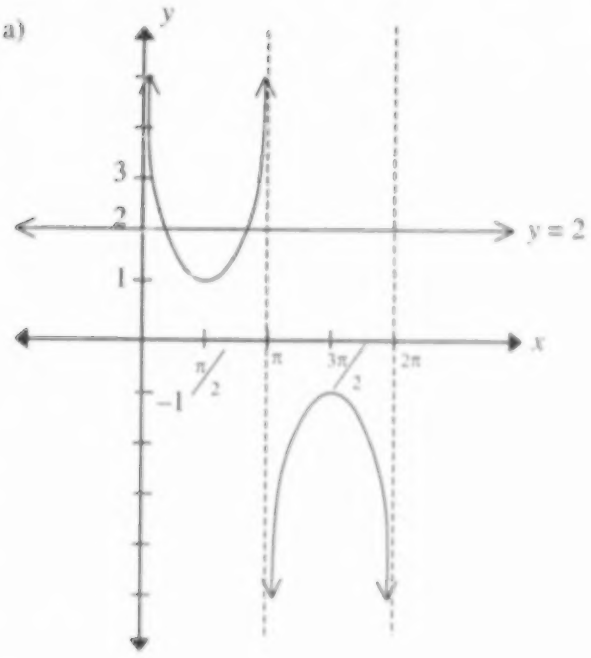
2 marks

b) On the above axes, draw the graph of the equation $y = 2$. Find the $x$-coordinates of the point(s) of intersection of these graphs in the interval $[0, 2\pi]$.

2 marks

## Solution

a)




2 marks
- 1 point for correctly labelled axis
- ½ mark for asymptotes
- ½ mark for general shape

b)

$$\csc x = 2$$

$$\sin x = \frac{1}{2}$$

$$x = \frac{\pi}{6}, \quad x = \frac{5\pi}{6}$$

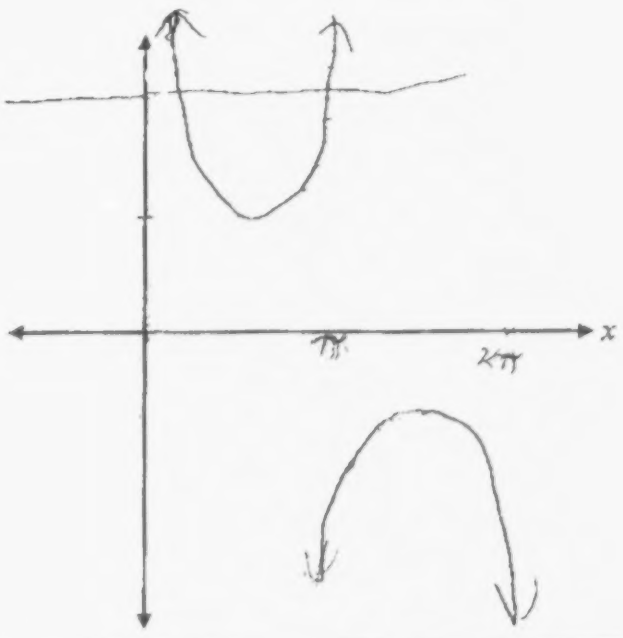
2 marks
- ½ mark for graph of $y = 2$ on above axis
- ½ mark for equating $\csc x = 2$
- 1 mark (½ mark for each value of $x$)

## Note(s)

- **deduct** ½ mark each for incorrect Max/Min point

# EXEMPLARS

51. a) On the axes provided, sketch a clearly labeled graph of the function $y = \csc x$ in the interval $[0, 2\pi]$. Include any asymptotes and/or intercepts which exist.




**Mark:** **1 out of 2**
**Note(s):** • ½ mark for shape and ½ mark for labelling $x$-axis

b) On the above axes, draw the graph of the equation $y = 2$. Find the $x$-coordinates of the point(s) of intersection of these graphs in the interval $[0, 2\pi]$.

$2 = \frac{1}{\sin x}$

$\sin x = \frac{1}{2}$

$RA = \frac{\pi}{6}$

$x = \frac{\pi}{6}, \frac{5\pi}{6}$ on $(0, 2\pi)$

**Mark:** **2 out of 2**

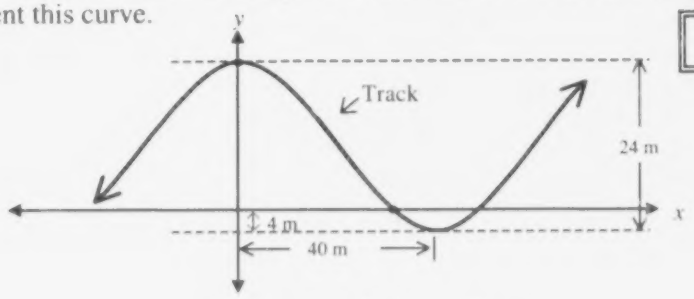
# Question No. 52

**Outcome: E2**

## Question

52. A portion of a roller coaster track is built in the shape of a sinusoidal curve as shown below. Find an equation to represent this curve.

3 marks




## Solution

$y = a\sin\left[b(x-c)\right]+d$

1) $2a = 24$
$a = 12$

2) Period = 80
$b = \dfrac{2\pi}{80}$
$b = \dfrac{\pi}{40}$

3) $c = 60$

4) $d = \dfrac{-4+20}{2}$
$d = 8$

Equation: $y = 12\sin\left[\dfrac{\pi}{40}(x-60)\right]+8$

Other possible solutions are:

$y = -12\sin\left[\dfrac{\pi}{40}(x-20)\right]+8$

$y = a\cos\left[b(x-c)\right]+d$

1) $2a = 24$
$a = 12$ ½ mark for value of $a$

2) Period = 80
$b = \dfrac{2\pi}{80}$
$b = \dfrac{\pi}{40}$ 1 mark for value of $b$

3) $c = 0$ ½ mark for value of $c$

4) $d = \dfrac{-4+20}{2}$
$d = 8$ 1 mark for value of $d$

Equation: $y = 12\cos\left[\dfrac{\pi}{40}x\right]+8$

$y = -12\cos\left[\dfrac{\pi}{40}(x-40)\right]+8$

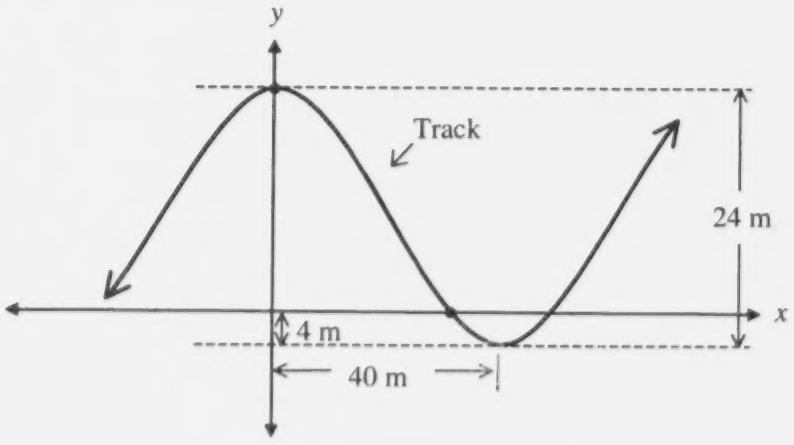
$y = 12\cos\left[\dfrac{\pi}{40}(x-80)+8\right]$

**Note(s):**

- deduct ½ mark if answer is not in equation form

# EXEMPLARS

52. A portion of a roller coaster track is built in the shape of a sinusoidal curve as shown below. Find an equation to represent this curve.




$T = \frac{2\pi}{b}$ $\quad 80 = \frac{2\pi}{b}$ $\quad b = \frac{\pi}{40}$

$12\cos\left(\frac{\pi}{40}x\right)+8$

| | |
|---|---|
| **Mark:** | **2½ out of 3** |
| **Note(s):** | • deduct ½ mark for not having an equation |

# Question No. 53

**Outcome: H1**

## Question

53. Positive numbers $a$, $b$ and $c$, are consecutive terms in a geometric sequence.

a) Show that: $b = \sqrt{ac}$ — 2 marks

b) If $b = 10$, show that $\log a + \log c = 2$ — 2 marks

## Solution

a) G.P. $: \frac{b}{a} = \frac{c}{b}$

$b^2 = ac$

$b = \sqrt{ac}$

2 marks { 1 mark for proportion; 1 mark for solving for $b$

b) $10 = \sqrt{ac}$

$100 = ac$ ½ mark

$\log 100 = \log(ac)$ ½ mark

$\log 100 = \log a + \log c$ ½ mark

$2 = \log a + \log c$ ½ mark

# EXEMPLARS

53. Positive numbers $a$, $b$ and $c$, are consecutive terms in a geometric sequence.

a) Show that: $b = \sqrt{ac}$

$b = (ac)^{1/2}$

$ac = b^2$

$b = \sqrt{(b^2)}$

$b = b$

$\therefore b = \sqrt{ac}$

| **Mark:** | **0 out of 2** |
|---|---|

b) If $b = 10$, show that $\log a + \log c = 2$

$10 = \sqrt{ac}$

$\log 10 = \log(\sqrt{ac})$

$1 = \frac{1}{2}\log a + \log c$

$2 = \log a + \log c$

| **Mark:** | **1 out of 2** |
|---|---|
| **Note(s):** | • deduct ½ mark for incorrect use of log theorems<br>• deduct ½ mark for algebraic error |